ELECTRICAL REVIEW

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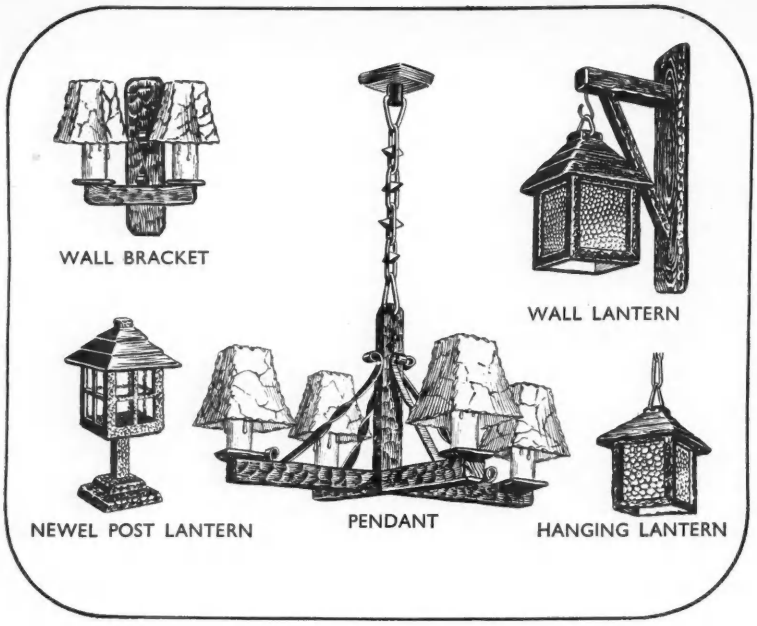

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ELECTRICAL REVIEW

16 April 1954 Vol. 154 No. 16 Established 1872

Submarine Power Cables

THE laying of power cables for any appreciable distance under the sea has lagged more than a century behind the laying of communication (telegraph) cables. An important reason, apart from the more complex problems arising out of the far higher voltages and heavier currents entailed, has been that until recent years electricity requirements could usually be most economically met at all times by generation in the country concerned. That position rapidly becomes less tenable with modern developments in high voltage transmission which often make it less expensive to take advantage of diversities in consumers' demands and in natural resources (irrespective of national boundaries) rather than to build power stations.

These considerations provide the chief immediate justification for proposals to link the British and French national transmission systems through cables in the English Channel. The attractions of such a scheme were evidenced by the very large attendance, which included many eminent foreign electrical engineers, and the high level of the discussion of the paper on the subject which was presented before the Institution of Electrical Engineers by Messrs. D. P. Sayers, M. E. Laborde and F. J. Lane and reported in our issues of 2nd and 9th April. The testimony then leaves no room for doubt as to the ability of the 138 kV cables themselves to meet the conditions. The main hazards appear to be purely external, such as those due to ships' anchors and trawls. The sea-trials off Dover have already resulted in the decision in Canada to use 138 kV cable of the same pre-impregnated design for a comparable scheme at Vancouver. Another large scheme, at 69 kV, for crossing the St. Lawrence River uses a second British design (external compression), which is a type favoured by French engineers.

Possibly the principal difficulty in the Anglo-French scheme would be in maintaining two large electrical systems in synchronism through the relatively small link between them. This drawback is, however, inherent in a.c. working which may not provide the final solution. To the recognized merits of d.c. for under-water transmission, which include the carrying of substantially more power for the same insulation, is added the advantage that conversion from a.c. to d.c. and *vice versa* would permit some variation in frequency between the two networks. Although there is room for uneasiness about external electromagnetic effects, e.g. in ships' compasses and sheath corrosion with d.c. (concerning which much will no doubt be learned from the Sweden to Gotland scheme), the predominant obstacle to its adoption is the present non-availability of rectifiers of large capacity. Yet because they will doubtless be needed, possibly within the next decade, for very long-distance transmission as well as for submarine transmission, their development in this country is imperative. The present a.c. scheme should go ahead, using three single-core cables with a fourth as spare, which could be used for d.c. operation when this becomes feasible. The national prestige value in any case would be immense.

THE PRE-WAR SPIRIT

In its 1952 report the Council of the British Electrical Development Association said that the year would be remembered as one which opened in an atmosphere of austerity and closed with brighter promise for the future. The report for 1953 presented at last Wednesday's annual meeting showed that the promise was being fulfilled. Indeed it was the first report since the war to recapture the spirit of progress and optimism which existed before 1939. This reversion to brightness was not confined to the Association. There was a better "ambient temperature"; the report said that "an increasingly favourable attitude towards electricity was very noticeable throughout the country." It is in this favourable atmosphere that the Association has launched its "Four Foundations of Modern Living" campaign with the certainty that good results will be achieved to the benefit of the public and the whole of the electrical industry.

SELECTIVE TENDERING

Architects and builders, through a Joint Committee whose report is reviewed in this issue, are in favour of abolishing the practice whereby local authorities or other public bodies throw open their contracts to general tendering by anybody who likes to take part. On the face of things the system is wasteful of time, effort and money on both sides. The Committee is accordingly in favour of restricting tenders to a limited number of concerns either by asking for applications to tender in the first place and selecting a number of suitable applicants or by maintaining lists of firms in various categories from whom tenders for particular contracts will be invited. Both systems require very careful handling if unfairness is to be avoided; they are both likely to make things difficult for the newcomer. The Committee is in favour of leaving the allocation of sub-contracts to the architect, or the main contractor under his direction. From a reference to the Committee made in the last annual report of the Federation of Associations of Specialists and Sub-Contractors (of which the Electrical Contractors' Association is a member) it may be anticipated that the Committee's recommendations will not be unanimously welcomed.

CANADIAN SPURT

At the end of last year the total turbine installation of hydro-electric plant in Canada was nearly 15 million h.p.; this is equivalent to just over one horse-power per head of the population, a figure exceeded only in Norway. The aggregate capacity of Canadian water power plant is surpassed only by that of the many times more populous United States. Against this background it is possible to appreciate something of the size of the construction programme now under way. New projects and extensions which are scheduled to come into operation this year total 1,500,000 h.p. and work is in progress on an equal amount of plant for completion in later years. These figures do not, of course, include thermal stations. To keep pace with the growth of demand brought about by the country's rapid industrialization, construction of new power developments has proceeded at night on floodlit sites and a number of projects have been completed ahead of the planned dates. Last year hydraulic production in Canada amounted to 61,608 million kWh compared with the total power generation in Great Britain—with a population four times larger—of 65,512 million kWh.

BUDGETARY CAUTION

The Chancellor of the Exchequer was no doubt right in deciding that present conditions did not warrant any significant change in taxation—either upward or downward. Any general reduction would have raised internal consumption at a time when exports are the first consideration. Any greater relief to industry than Mr. Butler was able to make in substituting an "investment allowance" for the "initial allowance" on capital expenditure would inevitably have fostered demands for higher wages. Although he may be accused of failing to provide "incentives" to more productive work the Chancellor has evidently seen that more money in hand does not always indicate greater production and if it does not the result is inflation. His caution will probably be seen to be justified later on.

ELECTRICITY SUPPLY BY-PRODUCTS?

In view of what we were shown at the Radiochemical Centre, Amersham, last week and of the fact that in the future electricity will be generated largely by means of atomic energy it is a reasonable speculation that radiochemicals may eventually form a substantial by-product of the electricity supply industry. In its comparatively short life the Centre has produced a catalogue listing several hundred radioactive materials and the demands of the chemists, biochemists, physicists and radiotherapists, in addition to those of industry, for newer radioactive products are increasing rapidly.

TRANSPORT COSTS

When we read of London Transport's latest application for permission to raise fares we could not help wondering if its increased costs were not at least partly due to the "dis-electrification" policy which that body is pursuing in connection with its road passenger services. One added burden to which London Transport referred in its explanation to the public was the higher fuel tax which it now has to pay. Maybe the London trams had become obsolete and troublesome but they could have been replaced by trolley-buses whose "fuel" is not taxed. Provincial operators of mixed passenger transport systems generally find that trolley-buses pay better than oil-engined vehicles. One point in their favour is their greater capacity. If they are replaced more vehicles are needed, each with its driver and conductor, adding considerably to labour costs. The Public Transport Association has issued a warning that the Chancellor's failure to reduce the fuel tax "must inevitably result in a flood of applications for increased bus fares throughout the country."

Resistance Wire Production

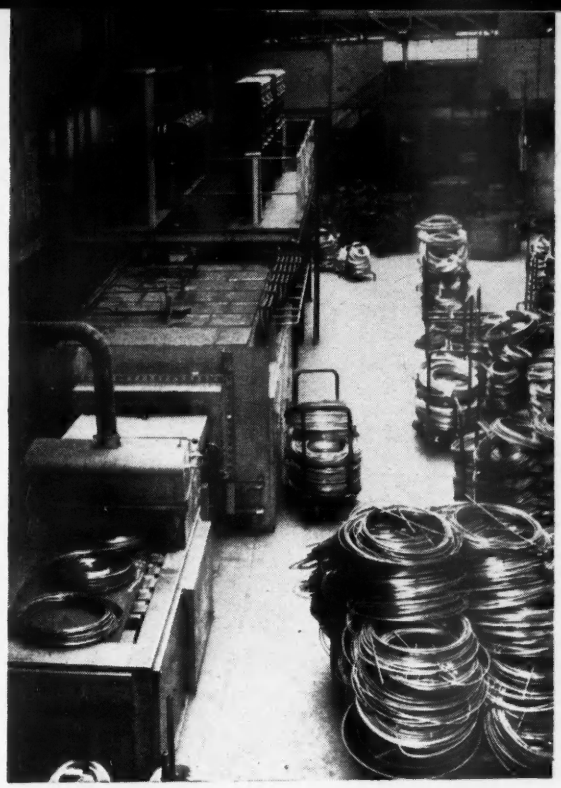
Techniques Employed in a Long-Established Business

THE trend of development in the materials used for the resistances of electric heating apparatus was described in some detail by Mr. H. Hodges in an article in the *Electrical Review* of 18th September last. He emphasized that careful control at each stage of production was a major factor in securing the reliability of the finished element. Indeed, the manufacture of electrical resistance materials is highly specialized and present-day practice reflects many years of practical experience and experiment.

Among the oldest and most important suppliers are Henry Wiggin & Co., Ltd., who have specialized in the production of high quality non-ferrous alloys since 1835. This company was originally founded under the name of Evans and Askin as "nickel refiners and German silver manufacturers." Henry Wiggin joined the firm in 1842 at the age of 18 and on the death of Askin during the same year he was taken into partnership in recognition of his "strict and energetic attention to studies and accurate scientific operations." Henry Wiggin not only laid the foundation of the business but also attained some eminence as an industrialist and took an active part in Birmingham civic affairs.

From its inception the organization has developed many new alloys to meet industry's demand for better materials and devised the means for making them economically. Nickel-silver alloys are no longer melted at the Wiggin Street works in Birmingham as the company now specializes in the production of high-quality high-nickel alloys. Broadly speaking these alloys can be divided into two groups: those used for electrical resistance purposes, and those possessing high temperature, mechanical or other special properties. This article deals with the production techniques employed in making electrical resistance alloys.

Tilting the high-frequency melting furnace for pouring



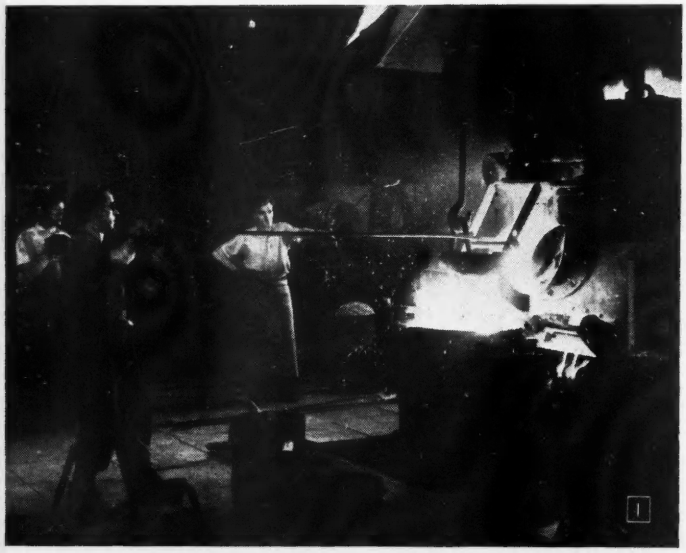
Annealing wire coils in a continuous "Birlec" belt furnace

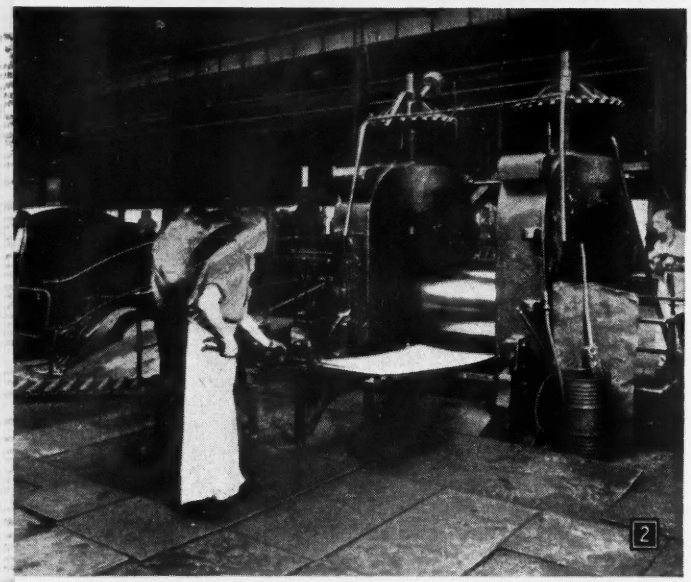
These alloys, which were first produced by Wiggin in about 1919, can only be made successfully by exact control of production with the most rigorous and constant checking at every stage, beginning with the analysis of the raw materials, by the use of the spectrograph, which make it possible to detect undesirable inclusions even to one part in more than 100,000. This check is important as both the hot-working and the electrical resistance characteristics are influenced by trace elements, which in some instances exert a beneficial effect but in others must be absent or kept rigidly below known safe limits. Checking and testing the electrical resistance of every coil of finished wire is also necessary and in the case of some alloys even at intermediate stages also.

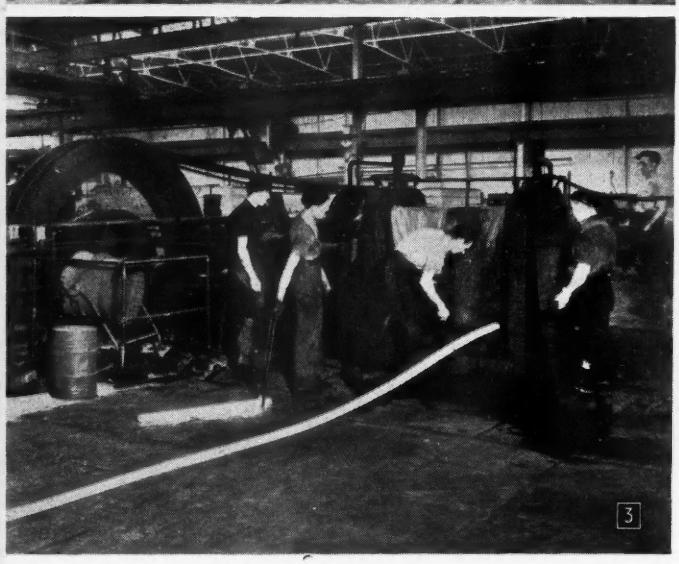
Essentially the alloys used for resistance purposes are of two types—the nickel-chromium alloys (the "Brightray" series) and the nickel-copper alloy known as "Ferry." The composition of "Brightray" alloys is, in the main, 80 per cent nickel and 20 per cent chromium, although some alloys may contain up to 42 per cent iron. A high electrical resistance is combined with a reasonably low temperature coefficient of resistance and good high temperature mechanical properties. They are used for all types of domestic and industrial heating elements at temperatures up to 1,150 deg C.

"Ferry" contains 55 per cent copper and 45 per cent nickel. It has a very low temperature coefficient of electrical resistivity and is used for instrument resistances, motor controls and starters, voltage regulators, and for thermocouple elements, in conjunction with iron or copper.

A vital part is played by electrical power in the production of these resistance alloys, from the initial melting of the raw materials to the final annealing, not omitting the use of the electric arc in the spectroscope used for the first checking. All the melting and interstage and final annealing is carried out electrically. The mechanical reduction in size involves the use of electricity whether hot-rolling, cold-rolling or wire-drawing. Auxiliary operations such as grinding, cropping, coiling and pickling also







need electrical power. Some idea of the scale of the operations at Wiggin Street can be gained from the fact that the monthly consumption of electricity varies from roughly 2·25 million kWh in the summer to 2·75 million kWh in the winter.

This power is supplied by the Midlands Electricity Board at 11 kV, three-phase, through three feeders to the works main substation. Here there are five Ferranti 1,500 kVA transformers which provide a 400 V three-phase supply for general works use. The substation also houses two Brush 500 kVA transformers giving a 400/230 V supply for the lighting circuits. In a separate substation there are two 11/3 kV 1,000 kVA transformers for the large mill motor drives and the h.f. furnaces. The h.v. switchgear in this substation was supplied by Johnson & Phillips, Ltd., and all the l.v. switchgear in the substations and 11 kV incoming oil circuit breakers supplied by George Ellison, Ltd.

Many of the wire-drawing machines require a d.c. supply to permit variable speed drive. To meet this need there are three 200 kW Metrovick glass bulb mercury arc rectifiers, two of which are in constant use feeding a ring main in the wire-drawing department. The third rectifier acts as a stand-by and it is possible to split the ring main into two parts and feed either part from any of the rectifiers.

The first stage in the production of resistance materials, the melting of the various alloys, is carried out in either Heroult arc or high-frequency (coreless induction) furnaces. The Heroult arc furnaces most frequently used each have a melting capacity of one ton. Three-phase 50 c/s power is supplied from a transformer with 70 V between phases. The rating is 650 kVA and for melting nickel-chromium and nickel-chromium-iron alloys a magnesite lining is used. The coreless induction furnaces also have melting capacities of one ton. These furnaces were supplied by Birlec, Ltd., the motor alternator sets being of B.T.H. manufacture. The rating is 750 kVA, the current being supplied at 1,200 V and 1,000 c/s.

The casting temperature is critical and for both types of furnace it is measured by means of a quick immersion thermocouple. The thermocouple wires are platinum and 13 per cent rhodium/platinum and have a silica sheath. The temperature is accurately indicated on a 24in diameter instrument mounted centrally in the melting shop.

The furnaces tilt to pour the molten metal into pre-heated ladles and from these the metal is poured into cast iron moulds already warmed to ensure complete absence of moisture. All these alloys have a large shrinkage on solidification and to reduce primary "pipe" and to eliminate any possibility of internal defects occurring on cooling a heavy current is passed through the metal while it is cooling and solidifying. The cast number and grade are then stamped on the cool ingot to maintain control of production.

Next, according to the end product, the ingots are either dressed by milling and planing, or broken down by rolling. The ingots are charged into oil- or gas-fired furnaces and particular care is taken to reduce the sulphur in the furnace atmosphere to 5 grains per 100 cu ft. The Universal mill is a "three-high" machine; it has three 18in diameter rolls ranged horizontally one above the other and 14in diameter vertical rolls for edge rolling. The distance between the rolls can be adjusted to enable square or rectangular shapes to be rolled, varying from $3\frac{3}{4}$in square for wire production to sheet bar measuring $7\frac{1}{2}$in by $1\frac{1}{4}$in.

The drive is a 750 h.p. 400 V induction motor running

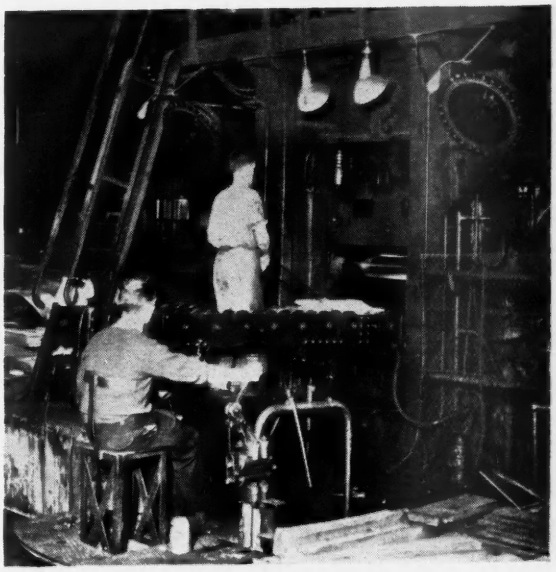
1. Tapping a Heroult furnace in melting department. 2. Pack rolling with the two-high hot-finishing mill. 3. Rolling "flats" on a 12in mill in the rod-rolling department

at 585 r.p.m. The driving gear unit transmits 1,500 h.p. with peaks of 4,500 h.p., and is capable of driving both the Universal mill and the Lauth (hot-finishing) mill. The gear ratio of 9·6 to 1 gives a speed of 61 r.p.m. to the final drive to the Universal mill. The screw-down gear for controlling the setting of the rolls is electrically operated and all three rolls are driven. To assist entry and delivery from the rolls and to feed the stock into the correct pair of rolls, the roller tracks are mounted on platforms which are hydraulically moved up and down as the billet passes to and fro. Each of the four sections of the roller track is driven by a 15 h.p. motor.

The first pass of the ingot through the rollers is used for squaring up; the ingot is then turned and rolled down to 0·9 to 1·5in thick with a reduction of about 0·5 in per pass. The bar is then cut into lengths and identification marks are stamped on it before the removal of defects in the fettling department. The ground slabs of nickel-chromium are, in general, further rolled to about 0·2in thick on the three-high Lauth mill which has a common drive with the Universal mill and a final speed of 36 r.p.m. The screw-down gear is electrically operated. Only the top and bottom rolls are driven on this mill. After this operation surface defects are removed by a " bobbing " operation before pack-rolling on a two-high finishing mill to the size required for cold-rolling. This mill is driven by a 600 h.p. 3 kV induction motor the speed being reduced from 245 r.p.m. through a single gear to 32 r.p.m.

The preliminary preparation for cold-rolling depends on the type of material which reaches this department, i.e., whether it is sheet or strip and also on the quality. The lowest thickness rolled is generally 0·01in for the " Brightray " alloys and 0·005in for " Ferry," the width in both cases being 3in; thinner and wider strip can be produced for special requirements.

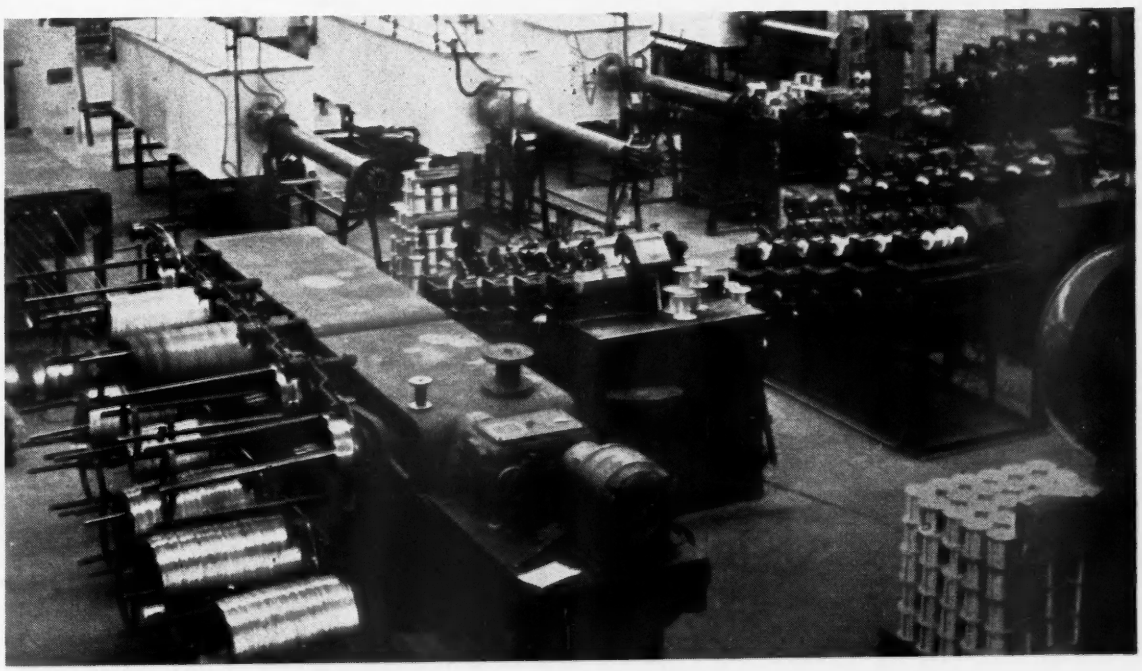
After annealing in a continuous belt furnace, " Ferry " sheet and strip is pickled to remove the oxide formed during hot working and annealing and then rolled with intermediate and final bright annealing to the customer's specification. In the case of " Brightray " alloys, the material is received as hot-rolled sheet and strip. The strip is batch annealed, while the sheet is usually annealed in conveyor furnaces in an atmosphere of partly burnt town's gas, before pickling and inspection. It is then rolled to specified gauge or resistance with intermediate and final annealing and pickling as required. Final checks are carried out on electrical resistance, width, gauge and surface.



Hot rolling slabs on the three-high sheetmill

To soften the material, it is necessary at some stages following cold working to anneal the alloys. This is generally done in an atmosphere of partly burnt town's gas or cracked ammonia, the latter being necessary to produce " bright-annealed " chromium-containing alloys. The electric annealing furnaces, supplied by Birlec, Ltd.,

The " Birlec " and Wiggin furnaces for continuous strand annealing are of a particularly interesting design



are of two main types; batch furnaces with an air atmosphere, or continuous furnaces of various types with controlled atmospheres. In some the material is conveyed on a belt, while in others, the " pusher " type, grids containing the stock are automatically pushed forward at predetermined intervals. Continuous strip furnaces take strip below 0·03in thick which is drawn through the furnace by winding it on a rotating drum.

Nowhere in the whole process of production is the skill and dexterity of the experienced operator so clearly demonstrated as in the rod-rolling department. The material is produced from round ingots or is first reduced from 3¾in square billets to 3⅜in diameter rounds in the 16in two-high rolls and then straightened at a speed of 25 to 30 ft/min on a Bronx reeler which is fitted with two 40 h.p. slipring motors. The next stage is roll cogging on a 16in mill where the billets are cogged to 1⅞in square and then reduced to ⅜in diameter rod in nine passes on the 12in rolls and four passes on the 10in finishing rolls.

When it is appreciated that at 1⅞in square the billets are 9ft long and weigh 112 lb and increase in length to 280ft when they are ⅜in in diameter, it will be realized that at the final stages the rod runs through the rolls at a very high speed, in fact about 650 ft/min. It is essential at these speeds that the teams should be made up of highly skilled operators accustomed to quick co-ordination.

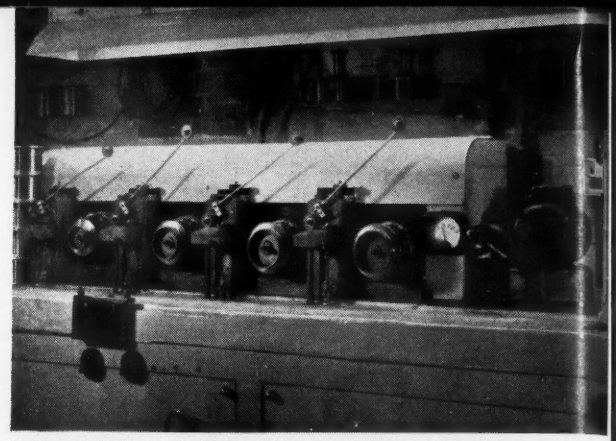
Manual dexterity alone, however, is insufficient. The nickel-chromium alloys are hard materials and can be worked satisfactorily only within a comparatively narrow range of temperature. Because of their hardness and toughness, only a small reduction can be made at each pass through the rolls. Although temperatures can readily be checked, the amount of hot working which is possible has been largely determined as a result of the years of experience which the operators have gained with these rather " difficult " alloys. The rod is finally hot-coiled to about 26in diameter before dispatch to the wire-drawing benches. The procedure in the rod-rolling department differs slightly for " Ferry " and for flats or strip in " Brightray."

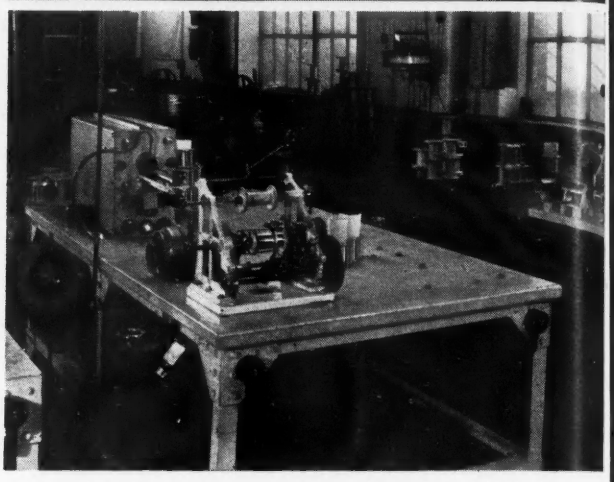
Before wire drawing can take place it is first necessary to remove the oxide formed on the " Brightray " rod during the previous hot working processes and to soften the material. It is therefore annealed in continuous belt type furnaces and then pickled. To lubricate the dies a coating is applied by dipping the coils into a bath of molten metal which has a flux cover. The first reductions are drawn on " bull blocks " in two passes down to ¼in diameter. After this, and indeed at intervals throughout the further reduction, it is necessary to anneal again, removing the metal coating before the wire is heated in the furnace and reapplying it before drawing recommences. This is necessary when the wire reaches 10 s.w.g. and again at 16 s.w.g.

" Ferry," which is a nickel-copper alloy, is not so hard and is more readily drawn. Flour is used for lubrication. This is applied after annealing by dipping the coils in a flour slurry and then drying them. After the bull blocks the " Ferry " wire is drawn to 16 s.w.g. (0·06in) in two runs on continuous machines.

Strand-Annealing Furnaces

Tungsten carbide dies are used for reduction to 0·03in diameter; for smaller wires diamond dies have to be used. Down to 16 s.w.g. single-die machines are used for the " Brightray " series, but below this multi-die machines are employed. The furnaces used in the later stages are of the strand-annealing type, of an interesting design. The furnace itself consists of a tube of nickel-chromium-iron alloy which forms the resistance in a circuit. Through this pass six small tubes, through each of which the wire is drawn, the feed being arranged so that adequate time is





Top: Fine wire-drawing on a machine designed and built at Wiggin Street. Below: Annealing very fine wire (44 gauge or less)

allowed for the wire to reach the desired temperature within the protective atmosphere and to ensure that it is cooled before it is again exposed to the air. The same type of furnace is used for any subsequent annealing which may be needed to produce the desired finish.

Some of the wire tests are according to British Standards but others have been introduced, especially at intermediate stages, as safeguards of quality. All " Brightray " wires are tested for resistance before dispatch and wire for heating elements is subjected to a spiralling test. Life tests on Bash and Harsch machines described in Mr. Hodges' article are regularly carried out to provide an additional check on the quality of " Brightray " wires. These tests subject the wire to conditions much more severe than those encountered in service.

The production of electrical resistance materials has been described in some detail. These, however, are only part of the wide range of high-nickel alloys produced at Wiggin Street. Also of interest to electrical engineers are the various grades of nickel produced for the radio and electronic industry, and the nickel-iron alloys used when controlled expansion properties are required. For other industries heat- and corrosion-resisting alloys, such as " Nimonic " alloys, " Inconel " and " Monel," produced by the organization are vital.

In common with other high-grade materials, the high-nickel alloys have presented problems in production and it is only long experience combined with close metallurgical control which enable their high quality to be maintained. Continuous work in the research laboratories has been needed to meet the demands of designers for even better materials to operate under increasingly severe conditions, and many of the nickel alloys now produced have properties which would have been unattainable in any metal a few years ago.

SOME OF THE PROBLEMS FACING THE DESIGNER

Aircraft Electrical Machines

By L. J. CLARK, B.Sc., M.I.E.E., A.M.Amer.I.E.E.

and A. HOSSLE, B.Sc.(Eng.), A.M.I.E.E.

THE electrical behaviour of airborne machines does not usually differ greatly from that of their earthbound counterparts. It is, however, computed that every pound of unnecessary weight in an aircraft may cost the user about £30 per year of operation, so that the minimizing of weight must rank high in the designer's outlook. He must also bear in mind that, while reliability is of paramount importance, the useful life of his apparatus will be limited by economic considerations such as obsolescence of the aircraft itself. The present-day standard life of aircraft accessories is about 1,000 flying hours between overhauls.

The essential materials in electrical machines (iron and copper) are, by aircraft standards, heavy materials. Various light alloys of aluminium and magnesium, etc., can largely be employed on other parts of the machine, such as frame castings, but discretion is necessary in their use since the mechanical properties of some of them suffer at temperatures which would not otherwise be considered unduly high. The weight of iron and copper in a machine can be minimized by running at the maximum speed and operating at maximum magnetic and electrical loadings, but to each of these limits are imposed by mechanical stresses, bearing problems and heating. With d.c. machines, commutation problems have also to be considered.

By the judicious use of the various available materials it is often possible to overcome some of these limitations, but the designer must also keep in mind the fact that the lightest machine will not necessarily result in the lightest aircraft installation. As an instance of this apparent paradox, the use of higher magnetic and electrical loadings in machines invariably results in higher values of current to be handled by the associated control gear. This usually entails an increase in the weight of this gear which may offset the weight saved in the machine. Also the use of high loadings results in increased losses and heating. Since the input power almost invariably comes from the aircraft engines the losses cause an increase of fuel consumption and therefore of weight of fuel to be carried, and not infrequently an increase in the weight of equipment to dispose of the heat.

In the case of wide-speed-range d.c. generators, in order to obtain stable operation in the upper part of the speed range, and under overload and shock load conditions, without resorting to excessively long air-gaps, compensating windings become necessary. These also assist in keeping to a minimum the shunt field copper losses, by reducing the shunt field ampere-turns and hence the size of the machine, and also of the associated carbon pile regulator for maintaining the input voltage constant under all conditions of load and speed.

Compoles are also essential in both 112 V and 28 V generators to assist commutation at high speeds, where reactance voltages are high. In small generators the use of compensating windings becomes impracticable and comparatively long air-gaps have to be used when wide speed ranges are required.

With large generators, with outputs of say 200 A, care has to be taken in the arrangement of the main connections to avoid compounding effects from the ampere-turns produced by the connections, which may lead to unstable operation. This usually means different arrangements of connections for either rotation.

Maximum speeds are usually about 10,000 r.p.m., with normal continuous operation at 9,500 r.p.m. and minimum speeds in the range 2,000 to 3,000 r.p.m.

The use of 112 V d.c. power systems on larger aircraft where power demands are high has led to the almost universal use of compoles on motors, except for the smaller sizes below, say, ½ h.p., in order to obtain satisfactory commutation and brush life.

In a.c. equipment the use of the highest practicable frequency gives a minimum weight of iron in the machine itself, and in the associated apparatus, and also favours the use of high running speeds. While radio and radar apparatus generally favour high frequencies these are not suitable for motors. In the earliest British airborne a.c.

installations frequencies of 250 c/s were used for three-phase motors and 1,600 c/s single-phase for radio and radar.

In the United States a compromise frequency of 400 c/s became general for both duties, and since the war there has been a tendency for British installations to follow suit. The latest indications, however, seem to indicate a tendency for radar apparatus to break away to still higher frequencies and for motor supplies to remain at 400 c/s.

The most suitable type of alternator for three-phase 400 c/s supplies is the salient-pole rotating field type, having six poles (running at 8,000 r.p.m.) or four poles (running at 12,000 r.p.m.). Fig. 1 shows a modern engine-mounted machine of this type. In these machines the field current is of course supplied through brushes and sliprings, and the machines therefore suffer, though in a reduced degree, the disadvantages which brush-gear and commutators impose upon d.c. machines.

For 1,600 c/s and higher frequencies the inductor type of alternator has found favour though in actual fact these frequencies are at the minimum end of the range for which the inductor type of machine is best suited. This type is of robust construction and easily ventilated but is inherently a high reactance machine. It also tends to be heavy compared with the salient-pole alternator.

In many radar applications the high reactance is offset by the use of series capacitors, which, while they enable the machine size to be considerably reduced, also limit the machine to a fixed frequency. This is no hardship for radar apparatus which requires close frequency control, but it precludes the use of direct drive from the aircraft's main engines.

To obtain maximum output from an inductor alternator it is necessary to make the air-gap the minimum and so small eccentricities such as can easily arise in manufacture can cause appreciable percentage variation in the air-gap. When they occur in both stator and rotor they give rise to a modulation in the voltage wave which is embarrassing to the radar user. Hence in these machines extreme machining accuracy is essential, as well as care in the design to avoid frame and shaft distortion from heating or other causes.

Inductor alternators also have an inherent tendency to generate both odd and even harmonics, though by careful design these can be minimized. A more serious effect, however, arises from the high inherent reactance which causes the wave-form of the output voltage to be susceptible to the wave-form of the output current.

Radar Apparatus Characteristics

Different varieties of radar apparatus present different load impedance characteristics to their supply sources; for instance, some kinds may be essentially resistive, others inductive or capacitive, while some incorporate rectifying elements. Each type of apparatus will therefore tend to demand from the alternator its own particular current wave-form, and in doing so will impose its own particular distortion on the alternator output voltage wave-form.

When, as often happens, different types of radar apparatus must operate simultaneously from a common alternator, the distortion due to one is liable to affect the performance of the others. This imposes a need for filtering devices between the alternator and its load.

Yet another difficulty arises when the load is of a rapidly fluctuating nature, such as may occur in apparatus demanding a series of pulses, or when large loads are suddenly switched in or out. In these circumstances the combination of an inductor alternator and series capacitors is liable to give rise to severe voltage surges which may cause damage to radar components.

To obtain maximum reliability in an aircraft installation it is desirable to parallel the generators to feed a common supply. While this is possible with d.c. generators the absence of a really satisfactory form of constant-speed drive has militated against this for a.c. installations. One form of hydraulic constant-speed drive is actually employed in some American military aircraft, but it has not been developed for general production. There are, however, good reasons to believe that in the near future gas or air turbines will provide the necessary constant speed drive and bring about a considerable increase in a.c. electrical installations in large aircraft.

Effects of High Altitude

A further set of problems arises from the fact that aircraft fly at high and increasing altitudes, and at high speeds. Present-day jet airliners fly at heights of 40,000 to 45,000ft and speeds of 400 to 500 m.p.h., whilst flight at altitudes of 60,000 to 70,000ft and speeds in the neighbourhood of 700 m.p.h. are envisaged in the near future.

The extremely low temperatures encountered at high altitudes, and high temperatures experienced at ground level in the tropics, both of which can occur within quite a short time, impose problems of differential expansion and bearing lubrication. It is necessary to find lubricants which are effective at the temperature extremes, though in some cases the difficulty is alleviated by the fact that both extremes are not encountered in a particular machine, for instance, machines situated in pressurized and air conditioned zones will not encounter extremely low temperatures, and so on.

At 45,000ft the density of air is about one-fifth that at sea level, and its temperature minus 40 deg C or lower. If a machine is air cooled, the mass flow of air required is proportional to the losses, and inversely proportional to the permissible temperature rise of the air. There must obviously be a temperature difference between the air and the parts of the machine which are to be cooled. The use of insulation capable of operating at high temperatures will help in increasing the available temperature differences.

It is not proposed to go into details regarding the laws governing this temperature rise, but clearly while the low initial temperature of the air at high altitudes is helpful in permitting a greater temperature rise of the air, the low density means that high velocities are necessary to get the required mass flow of air to carry away the heat generated by the losses in the machine. Now to drive air through the machine necessitates a difference of pressure between the air inlet and outlet. In most aircraft to date this pressure difference has been obtained by collecting the air in forward facing scoops, and thus employing the "ram" effect of the velocity of an aircraft relative to the air in which it is flying. At low air velocities the pressure difference across the machine is proportional to the square of the velocity, but as the velocity of sound is approached the pressure required increases at a much greater rate.

To obtain the necessary flow of air, at high altitudes then, the high velocities necessitate high pressure heads, but since the surrounding air density is low it becomes increasingly difficult to obtain the necessary pressure, which in any case cannot exceed $\rho V^2/2g$ where ρ is the air density and V the aircraft speed. Moreover the air scoops increase the drag on the aircraft and so detract from its performance. The machine designer must therefore keep the air impedance of his machine to the minimum by providing adequate air passages, at the same time ensuring that their size and configuration are such as to ensure adequate removal of the heat.

It generally happens that long before the necessary auxiliaries are considered the design of the aircraft has

proceeded so far that space for the auxiliaries is restricted. While the machine designer, with all the foregoing considerations in mind, would prefer to make his machines "short and fat," he is forced to make them "slim and not too long."

In the past many of the above design features have been met by intuitive and "rule of thumb" methods, and the aircraft designer has been called upon to make adequate provision in the way of air supply. With the trend of modern aircraft development it is becoming increasingly difficult for the aircraft designer to meet the requirements of the machine designer, who must therefore make the best of what is available. This involves a study of the laws of heat transfer, aerodynamics and thermodynamics.

With modern aircraft speeds and altitudes a further complication is coming into the picture. When air passes at a velocity of V m.p.h. across a stationary surface it acquires a "velocity temperature" of $(V/100)^2$ in proximity to that surface, which must be included in the temperature difference between the air and the surface to be cooled. This velocity temperature is the adiabatic temperature rise incurred in changing the velocity (and therefore the kinetic energy) of the air in immediate contact with the surface from that of the surrounding air to that of the surface. When air enters the air scoop of an aircraft a velocity change takes place and its effective temperature increases by the corresponding "velocity temperature" thereby reducing the available temperature difference for cooling the machine.

The outcome of these factors is that aircraft performance is approaching the stage when machines can no longer be directly cooled by ram air, and other means must be considered. Some classes of machines, e.g. invertors, etc., which can be carried in pressurized portions of the aircraft, can be cooled by air drawn from the pressurized zone, and the air either discharged into this zone or discharged overboard. Among the methods being considered for dealing with this problem are closed circuit systems in which air or other gas or liquid coolants are circulated around closed circuits including heat exchangers, and expendable systems in which water or other liquids, vapours or gases are injected into the machines and discharged overboard, after absorbing heat.

Clearly the choice of a system depends upon the class of duty the aircraft is required to perform. As an instance, in a high speed fighter or rocket aircraft having a short operating time it may be possible to carry enough expendable coolant to last the duration of a flight, while for a long distance aircraft the weight of expendable coolant would be prohibitive.

With flying speeds already envisaged, the "velocity temperature" on the outer skin of the aircraft will become so great that it may be necessary to discharge heat from the aircraft at a higher temperature than is permissible in the machine itself. For long distance aircraft this will necessitate the consideration of closed circuit cooling systems, incorporating "heat pumps" to step up the temperature, so as to enable the heat to be shed.

Brush Wear

Another problem which arises under high altitude conditions is that of rapid brush wear. Although brushes are worked at comparatively high current densities and with high spring pressures, rates of wear are generally not more than 0·0002 to 0·0003in per hour giving a life of about 1,000 hours under low altitude conditions. However, with the extreme dryness at altitudes above 25,000ft the normal mechanism of lubrication between brush and commutator or slipring breaks down. The high rates of wear which follow may result in brushes wearing out in a few minutes.

The onset of this high rate of wear follows the disappearance of the film formed on the surface of the commutator or slipring during the bedding of brushes and maintained under normal low altitude operating conditions. In order to maintain the film at high altitudes brushes have been impregnated with various materials, with varying degrees of success.

The efficacy of such treatment depends to a great extent on the quality of commutation and on the mechanical design of the brush-gear. It is unfortunate that, in general, the application of high altitude treatments to brushes results in deterioration in their commutating and collecting ability and hence in the quality of commutation. Thus to obtain satisfactory brush life at high altitude the rated output of a generator may have to be reduced by as much as 25 per cent. The use of treated brushes also leads to higher brush and commutator temperatures, requiring additional cooling or de-rating to maintain permissible temperature rises.

In order to increase the temperature at which commutators may be worked many generators now have brazed commutator connections and solid or brazed wire binding bands. Fig. 2 shows a typical armature having brazed commutator connections and binding bands. With the increase of both speed and temperature, the limiting

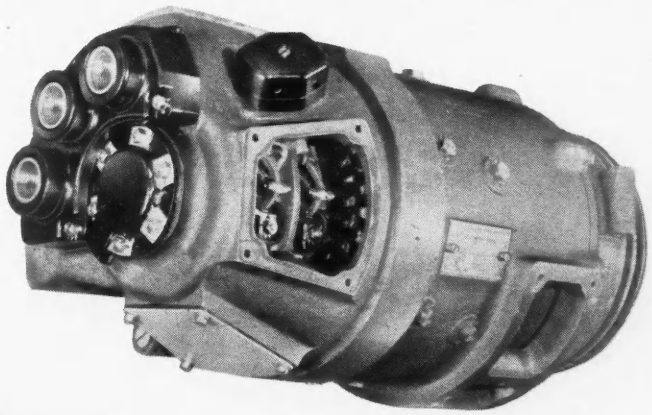


Fig. 1.—Modern engine-mounted three-phase 400 c/s salient-pole alternator

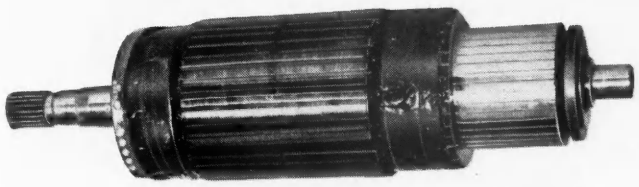


Fig. 2.—Armature for a 200 A, 28 V d.c., 4,000/10,000 r.p.m. engine-driven generator

stresses of existing materials are being approached and it is becoming necessary to consider the use of other forms of construction and stronger materials for the commutator bars.

An alternative to the use of impregnated brushes is to humidify the atmosphere in which the brushes work. With the introduction of new methods of cooling, mentioned earlier, this becomes possible either by enclosing the commutator and air-gap zones or by using a closed circuit for the cooling medium.

In the case of sliprings where commutating conditions are absent and operating temperatures are generally lower, the high altitude wear problem can usually be overcome by the use of treated brushes. At the high rotational and peripheral speeds encountered in aircraft machines the "truth" of the commutator or slipring surfaces is of the utmost importance with regard to both total and bar-to-bar eccentricity. The latter may be affected very considerably by high temperature gradients and centrifugal stresses, depending on the form of construction.

Fairly high spring pressures, of the order of 4 to 6 lb/sq in for continuously rated machines, are used in order to reduce the effects of eccentricity and vibration to a minimum. In some applications accelerations due to vibration may be as high as 100 g.

Radio Interference Suppression

Another very important requirement with the increasing use of electrical machines in aircraft is the reduction of radio interference from d.c. machines. This is usually accomplished by fitting capacitors or a choke-capacitor network in each piece of apparatus likely to cause interference.

In a large number of cases, by making use of the inductance of series windings, satisfactory results can be obtained by means of capacitors alone. To facilitate this, the series windings are split on either side of the armature. Specially constructed capacitors, effective over a frequency range of 150 kc/s to 150 Mc/s or higher, are available for this purpose. The normally acceptable limit of radio interference voltage at the machine terminals is 100 μV.

Applications

With the increase in size of aircraft and the comparatively long distances between points at which work has to be done, electric drives have in many cases replaced hydraulic devices. In some cases electro-hydraulic units are employed to avoid the use of long high pressure hydraulic pipe lines.

Electric motors are consequently used for such vital services as flying controls, flaps, under-carriages and emergency propeller feathering. Other applications include windscreen wipers, de-icing pumps, air circulating fans, cooling fans for radio and radar equipment (see Fig. 3), computing devices and remote instrumentation, using synchro elements. In a large number of cases the power unit takes the form of an actuator comprising an electric motor and screw jack.

The safety of many modern aircraft may depend entirely on the electric motors operating the flying controls. This necessitates reliable power supply and control and protection systems. As many of these machines are mounted outside the pressurized zone of the aircraft in remote positions, they present the same problems of brush wear and cooling as the engine-driven generator. In addition they are generally required to be self-cooled for ground operation, including servicing. Consequently their fans have to be designed to give satisfactory cooling at ground level, and also to deal with high volumetric flows under high altitude conditions. A machine of this type is shown in Fig. 4.

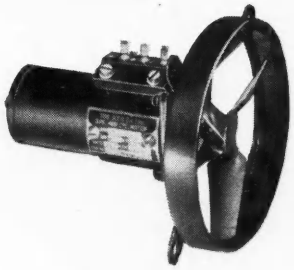


Fig. 3.—Three-phase 400 c/s motor-fan unit for cooling radar equipment. Output 60 cu ft/min; weight 7 oz

Fig. 4.—A 112 V d.c. motor for flying controls. Rating, 1·5 h.p. continuous at 5,800 r.p.m.; 5·2 h.p. peak, self and forced ventilation; weight, 25 lb

The mounting of accessories in remote or otherwise inaccessible positions necessitates quick release mounting arrangements for ease of maintenance. Such devices need to be releasable from a single point of access. Arrangements such as that shown in Fig. 5 are now being adopted and standards are being drawn up by the S.B.A.C. Similar requirements arise where a number of accessories has to be mounted in close proximity on a single engine driven gear-box and the use of conventional bolted flanges is impracticable.

When machines are to operate at high speeds, accurate dynamic balancing is necessary to avoid excessive vibration which besides reducing bearing life, causing noisy operation and affecting the performance of the brush-gear, could, in the case of large machines, cause fatigue failure of mounting flanges. In modern machines balancing rings (see Fig. 2) are specially provided to facilitate this operation which is carried out on very sensitive machines; these indicate both the amount and the position of the correction required, in each of two planes. Methods of balancing such as the addition of solder to banding wire are not permissible or practicable on machines designed for operation at high speeds and high temperatures, for obvious reasons.

Converting Plant

With the increasing use of radio and radar navigational and landing aids, the considerable amount of a.c. power required at both 400 c/s and 1,600 c/s is usually provided by motor generator sets. These are of two- or three-unit construction in a single frame, the latter providing both 400 c/s and 1,600 c/s outputs.

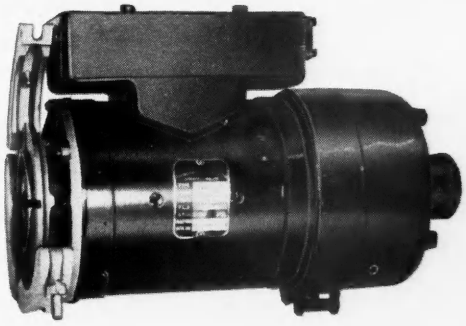


Fig. 5.—Example of "V" clamp and flange for quick-release mounting of d.c. motor

Fig. 6 (Right).—Flameproof, self-cooled motor-generator set with carbon pile voltage and frequency regulator. Output, 115 V, 1,600 VA, 0·8 p.f., three-phase 400 c/s; input, 25/28 V d.c.; weight, complete with regulator, 55¾ lb

With d.c. power systems it is possible using carbon pile, electronic or magnetic amplifier regulators to control accurately the output voltage and frequency of these machines. In some cases accuracies of ± 1 per cent are required, under all conditions of load, temperature and input voltage. An example of a two-unit motor generator set giving a three-phase, 400 c/s output and having output voltage and frequency regulated, is illustrated in Fig. 6.

Where motor generators are mounted in unpressurized parts of the aircraft cooling problems are often acute, particularly as such machines are generally rather long and comparatively small in diameter. In civil aircraft, motor generators and many other continuously rated machines may be mounted in the comparatively large pressurized zone. In these circumstances they are usually required to be flameproof. This necessitates a supply of air free from inflammable gases, possibly from the passenger cabin exhaust, and the use of flametraps in both inlet and outlet, to prevent propagation of flame outside the machine if sparking at the brushes or an internal fault ignite an accumulation of inflammable gas inside the machine.

Engine Starting

One of the oldest applications of electrical machines is that of engine starting. The problem of starting a modern gas turbine engine differs considerably from that of the piston engine. Whereas the latter requires steady turning at a comparatively low speed, the former requires to be accelerated to a comparatively high speed where lighting up takes place, and then assisted to a higher speed at which the engine becomes self-sustaining. At a speed slightly in excess of this the starter has to be automatically switched off.

As in this case the motor is accelerating throughout its working period, control equipment is necessary to maintain the input current within acceptable limits with regard to both the power supply and the motor's performance. If the engine fails to start the motor has to be automatically switched off. Moreover, once one engine of a multi-engined aircraft has been started, constant voltage power becomes available from the engine driven generator and further precautions are necessary to take care of the increased voltage which would appear at the starter terminals. The voltage is about twice that available at peak power when starting off the battery.

As starting from the aircraft's own battery is required, the amount of power initially available is limited, hence also is the rate of acceleration. With the advent of larger engines or where quick starts are required it is becoming increasingly necessary to adopt other means of starting. In some types of gas turbine the problem is alleviated by initially starting only part of the engine.

In this brief article it has been possible to touch only on some of the many problems of the machine designer. Some of these necessitate co-operation with designers of the airframe and other accessories. There are many problems which come outside the direct sphere of the machine designer, but yet have a bearing on the machine design itself, and if the best results are to be achieved the machine designer must look beyond his own immediate problems. It will also be apparent that despite, or rather because of, fifty years of progress in powered flight new problems are continually being presented to the designer.

The authors wish to thank the directors of the British Thomson-Houston Co., Ltd., for permission to publish this article.

Protection of Oil Tanks

AT a meeting of the North-East Coast Institution of Engineers and Shipbuilders on 26th March a paper was presented by Messrs. J. Lamb, E. V. Mathias and W. G. Waite on the cathodic protection of the interior of cargo compartments in oil tankers. The authors referred to the alarming increase in wastage due to corrosion in recent years and described trials carried out for twelve months on the 12,250 ton D.E.S. *Auris* carrying "white oil." By means of the galvanic method adopted heavy scale was first shed rapidly and the reduction in corrosion was about 75 per cent near the bottom and only slightly less in the upper region of the tanks. The cathodes were provided by the steel to be protected and the anodes by magnesium alloy. Magnesium was chosen because it provided a higher voltage (1·11 V) than other suitable reactive metals, e.g., zinc and aluminium (0·32 and 0·89 V) and did not, as they did, tend to form a self-protective scale which restricted current flow. It was, however, consumed rapidly and unevenly so a special alloy was produced containing small percentages of the other two metals. Provision was made to exclude the possibility of explosion risks due to the evolution of hydrogen. Hydrogen embrittlement could be neglected in view of the small current densities possible. It was shown how the same basic principles could be adapted for tankers carrying crude oil.

Contractors' Employees on Customers' Premises

By C. F. MAYSON, A.M.I.E.E.

Responsibility for Their Safety

IT is well settled law that the occupier of premises (who may be the owner or a tenant, but must actually be in occupation) who employs a contractor to do work on those premises is under a duty to give fair warning of any unusual danger about which he knows or ought to know. If he fails to do so and one of the contractor's employees is injured in consequence, then he will be liable in damages. The extent of his responsibility is restricted to giving warning of dangers which are unusual to the person who comes on those premises; it is the duty of that person also to have a reasonable regard for his own safety.

But what if the premises are unoccupied and the contractor's employee is injured? Is the contractor then responsible? This was considered recently by Mr. Justice Byrne in the Queen's Bench Division in the case of *Cilia* v. *James*.*

The defendants in that case were plumbing contractors, engaged in the installation of hand basins and water closets in an unoccupied dwelling house. The plumber told his mate to go into the loft to attend to a defective ball valve, and the mate was later found dead, lying across the cistern. The floor of the loft had been covered by the owner with steel sheets, one of which was resting on an electrical conduit, which was "live." Although the mate was known to have a weak heart (and death was consistent with heart failure), it was a fair surmise that he had been killed by electric shock.

Had the house been occupied, it would have been a question of fact whether the dangerous electrical condition in the loft was one about which the occupier should have given warning. But there was no occupier, and the widow of the deceased man brought an action against the contractors, his employers. The action failed, because it was held that the contractors owed no duty to their employee with regard to the safety of the premises.

Extent of Employer's Duty

How far, then, is an employer responsible for the safety of his employees when they are working on a customer's premises? In the ordinary course of events he is bound to provide safe and suitable plant and equipment and a safe place in which to work; he must also institute a proper system for, and exercise proper control of, the carrying out of the work they have to do.† It is obvious, however, that if the place of work is provided by someone else, the employer cannot be held responsible for its safety. But his liability to provide suitable plant and equipment and to initiate and maintain a safe system of work remains.

It follows, therefore, that it is for the employer, by instituting a safe system, to guard against those dangers which are obvious (or, at least, not unusual) and which are present in any premises where his employees are working. If the danger is an "unusual" one, which is or ought to be known to the occupier, then, if no warning has been given, liability is shifted from the employer. But if the occupier has given warning, it will be the employer's duty to see that his employees are properly protected.

In initiating a safe system for employees who are working on a customer's premises, the employer must take those premises *as he finds them*. Those last four words are significant, for, with his knowledge and experience, the employer is expected to look out for the sort of dangers normally to be found on premises of the kind with which he is concerned. There are certain risks which are recognized in every trade, but if, in a particular case, the risks appear too great, it is for the employer, in consultation with his customer, to find a way of surmounting them. To expect an employee to take a greater risk than he would normally be prepared to take is not justified, even where that employee apparently accepts it, for the presumption is that no employee is capable of giving a true assent to a risk which might result in injury to himself.

Previous Decisions

Two cases concerning window cleaners have thrown some light on this question. Sash windows are particularly common in large and high buildings, and the accepted method of cleaning the outside of such windows is for the cleaner to stand on the sill and support himself by holding on to the bottom of the upper sash, the lower one being raised. It is not unknown for sashes to be insufficiently counterweighted, so that they may drop of their own accord or at a slight touch.

In *Christmas* v. *General Cleaning Contractors, Ltd.*,‡ the House of Lords affirmed the decision of the Court of Appeal that, although a defective sash may be a usual danger to a window cleaner (so that the occupier is under no duty to give warning, and will not be responsible if an accident occurs), it is a danger against which his employer should provide some sort of safeguard. The cleaner in that case lost his handhold because the lower sash dropped, and he fell. It was held that, the use of safety belts or ladders being impracticable, the employer had not provided a sufficiently safe system of work. Knowing that this type of window was apt to be defective, he should have provided something, such as a wedge, to prevent the lower sash closing, and should have ensured that his employees clearly understood that it was to be used.

In *Drummond* v. *British Building Cleaners, Ltd.*,§ a similar accident occurred, but Mr. Justice Pilcher decided that, as the fall was not due to a defective sash but to the cleaner's foot slipping on the sill, the employer was not liable.

What it amounts to is this: in the case of unoccupied premises, the only danger for which the employer is not responsible is an unusual danger which his experience would not lead him to expect. But if the premises are occupied, and the occupier has given warning of such a danger, he, and not the occupier, will be liable in the event of an accident. On the other hand, should the danger be one which neither the employer could anticipate nor the occupier have knowledge of, an employee who is injured as a result will have no remedy.

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* *The Times*, 31st March, 1954.

† See "Safe Systems of Work," C. F. Mayson, *Electrical Review*, 28th March, 1952.

‡ (1953), *Law Reports Appeal Cases* 180.

§ (1954), 1 *The Weekly Law Reports* 501.

VIEWS on the NEWS

By REFLECTOR

THE necessity of providing accommodation for men working on new power stations for the British Electricity Authority seems to raise a number of unexpected points. For instance, the Portishead Urban Council has agreed to erect 100 houses for people employed on the power station in that district but it has stipulated (reports the *Western Daily Press and Bristol Mirror*) that, as Portishead ratepayers derive no direct financial benefit from the erection of the new generating station, they should not be called upon to find the rate subsidy for houses of the Authority's employees. The B.E.A. refused to pay the subsidy and when the local M.P. (Mr. E. H. Leather) raised the matter with the Minister of Fuel and Power he was told that the matter must be settled between the Council and the Authority. His view was that as the B.E.A. was compelled to make a contribution for the benefit of local authorities, in lieu of rates, there would have to be a very special reason before it paid any more. The Council decided to inform the B.E.A. that the erection of the houses would be contingent upon its employees paying 2s 6d a week extra rent, the reason being explained by the Authority to the employees.

* * *

Power station operators in this country occasionally have trouble from stray cats, rats and mice which get caught up in busbars and interrupt supply. In Africa, of course, the intrusion of larger fauna may be expected. A short time ago, the Uganda Information Department says, a control engineer at the Owen Falls plant (which the Queen is inaugurating on 29th April) found a hippopotamus rolling down a corridor at the station. Fearing for the safety of a large array of instruments the engineer tried to divert it from the control room. The animal charged at him and in his hurried retreat he fell and hurt his shoulder. Nevertheless he succeeded in warding off the hippopotamus which, unable to negotiate a flight of stairs, made its exit by smashing through some windows and strolled away without causing further damage.

* * *

People who move from a town to the country do not usually appreciate the blackness of the rural night. Yet there are exceptions, one of them being a woman at Wivelsfield who wrote to the local Council in protest at an electric lighting extension which it is proceeding with. She says that she is much disgusted at the idea of street lighting spoiling a country lane and fears that a lamp near her house will drive away the nightingales. She hoped that by leaving London she had left street lights for ever. The Council has declined to be deflected from its purpose but has promised that the lamps will not be used during the summer months.

* * *

After contributing "Midland Commentary" to the *Electrical Contractor and Retailer* for over fourteen years Mr. W. A. Gazard, of Birmingham, appears for the last time in the April issue, having decided to exchange electrical contracting for other interests less exacting and allowing him "more leisure with less anxiety." I think, however, that when he suggests to possible successors that there is nothing in the task of writing such a regular commentary he is rather under-rating what he has been doing. He says:—

> "It is an advantage to be able to read and write, but beyond that modest talent it only means sitting down and dashing off whatever comes to mind."

As a member of this tribe, I warn aspirants that there are times when nothing will come to mind: when one really appreciates the position of the ancient Israelites in their brickfield.

* * *

There are of course in this country women engaged in various duties at power stations, but I have not before come across one actually in charge of a station. A further stage in the equality of the sexes is, however, now apparent in South Africa where Mrs. W. J. Higgo, of Williston, North West Cape, took over from her husband when he became ill. He was a self-taught electrician who passed on his knowledge and skill to his wife. She is now able to do minor running repairs, and besides working the ordinary shifts, night as well as day, also keeps an eye on the pumps of the town's water supply which are operated electrically. She has three male assistants, one of whom she has trained herself. During the three years she has been in charge of the station there have been no supply failures.

* * *

In view of the celebration of the bicentenary of the Royal Society of Arts, reference to a note in the *Electrical Review* of eighty years ago (15th April, 1874) may be appropriate. In this it was recalled that among the ten awards of the Society's Albert Medal which had been made up to that time were those to Michael Faraday (1866) and, jointly, to W. Fothergill Cooke and Charles Wheatstone (1867). Faraday received the medal for his "discoveries in electricity, magnetism and chemistry which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures and Commerce." The award to Cooke and Wheatstone was in recognition of "their joint labours in establishing the first electric telegraph." The *Electrical Review* put forward the name of Sir William Thomson (later Lord Kelvin) as a worthy candidate for the 1874 medal but in the event it went to Sir William Siemens who had been the first president of the Society of Telegraph Engineers in 1872 and served in that office again in 1878. Thomson received the Albert Medal in 1879.

* * *

Magazines and news sheets form the subject of an article in the March issue of *British Electricity* (the journal of the B.E.A.). Every magazine, it is said, should have its own "puzzle corner" for "readers are entertained and informed at the same time by such questions as 'What function does an exciter serve in a turbine rotor?'" I am waiting to be informed.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Mr. F. J. Lane, O.B.E., M.Sc., M.I.E.E., whose appointment as deputy chief engineer (transmission) of the British Electricity Authority was briefly reported in our last week's issue, joined the Central Electricity Board as technical assistant for South-East England in 1934 after experience with Crabtree & Sons, Leeds, the British Thomson-Houston Co., Ltd., Rugby, and the Yorkshire Electric Power Co. Three years later he was promoted to technical engineer at the head office of the C.E.B., with special responsibility for protective gear and for system development in Northern England. He was placed in charge of the system development section in 1946. On nationalization he was appointed transmission design engineer of the B.E.A. at headquarters. Mr. Lane was chairman of the Measurements Section of the Institution of Electrical Engineers for the 1951-52 session.

Mr. F. J. Lane

Bulpitt & Sons, Ltd., announce that **Mr. H. L. Wickes,** A.M.I.E.E., has resigned his position with the Brush Electrical Engineering Co., Ltd., and has taken up an appointment as sales manager with B.K.B. Electric Motors, Ltd., Birmingham, the associate company of Bulpitt & Sons.

Mr. J. T. Moore, B.Sc., M.I.C.E., M.I.Mech.E., M.I.E.E., A.M.I.Mar.E., chief engineer of the English Electric Co., Ltd., is relinquishing his present position this month to take up a directorship with Ewbank & Partners, Ltd., consulting engineers.

Mr. J. T. Moore

Mr. Moore served his engineering apprenticeship with the Fairfield Shipbuilding & Engineering Co., and graduated from Glasgow University in 1925. He continued for a further year on advanced studies and research at the Royal Technical College, Glasgow, qualifying for the Associateship of the College in 1926. In the same year he joined British Brown Boveri, London, and in 1934 was transferred to Richardsons Westgarth-Brown Boveri, Ltd., as assistant general manager. In 1936, Mr. Moore became sales manager of the steam turbine division of the English Electric Co., at Rugby, and in 1945, manager of the division. He was appointed chief engineer of the company in 1948.

Mr. S. Cornthwaite has been appointed Midlands sales manager of Marryat & Scott, Ltd., and will operate from the Birmingham office at 41, Water Street. Mr. Cornthwaite has been in the lift industry for twenty-five years.

At the annual meeting of the Electrical Society of Glasgow, held on 6th April, **Mr. W. E. Macdonald,** A.M.I.E.E. (General Electric Co., Ltd.), and **Mr. J. S. Denholm** (contractor) were elected president and vice-president respectively.

Mr. C. C. Last, director and joint general manager of Bakelite, Ltd., was elected vice-chairman of the British Plastics Federation after the recent annual general meeting. He has been closely connected with the Federation since its inception, and before its foundation was a member of the Council of the British Plastics Moulding Trades Association. He has been a member of the Council of the Federation for the whole of its existence and in addition he has been a member of the Executive Committee for many years, chairman of the publicity committee for fifteen years, and at various times chairman of the Plastics Material Manufacturers' Section. As we have already reported, **Mr. A. E. Skan,** a director of the Ellison group of companies, is the new chairman of the Federation.

Mr. C. C. Last

Mr. C. J. Blackett, Bristol district engineer of the South Western Electricity Board, has been appointed district commercial manager for Bristol South and will take up his new duties later this month. He succeeds **Mr. H. F. Lidster,** who after four years in Bristol South is taking up an appointment with the North Western Electricity Board at Blackpool. Mr. Lidster was recently presented with a travelling clock by colleagues at Bristol South.

Mr. Blackett has served in the electricity supply industry since 1935 when he was a student with the Bristol Corporation Electricity Department. He was an engineer at Portishead power station for two years and joined the Mains Department in Bristol in 1938.

Mr. H. F. Farmer, who for nearly forty-eight years was closely associated with the design and production of electrical control gear, retired from the British Thomson-Houston Co., Ltd., on 9th April. Mr. Farmer started with the company in 1906 and in 1913 he joined what was then known as the Rheostat and Controller Engineering Department, becoming chief assistant to Mr. H. C. Hastings in 1919. He was engaged on control gear design until 1930 when he took over the post of superintendent of the B.T.H. control gear factory, a position he held for twenty-two years. In 1951 he asked to be relieved of this responsibility but remained with the company as a consultant on matters concerning control gear. Mr. Farmer is a past-president of the Rugby Engineering Society, a founder member of the British Works Managers' Association and a Fellow of the Institution of Works Managers.

Mr. H. F. Farmer

Mr. H. Taylor has retired from the board of Mather & Platt, Ltd.

Mr. Richard Stevens, B.Sc., M.S.I.A., has joined the Atlas Lighting Division of Thorn Electrical Industries, Ltd., and will be responsible for street lighting development. He was recently with the Metropolitan-Vickers Electrical Co., Ltd., and previously with Siemens Electric Lamps & Supplies, Ltd.

Mr. R. Stevens

Addressing 200 guests at the annual dinner-dance of the **I.E.E. North Eastern Centre** at Newcastle-on-Tyne on 26th March, Mr. S. E. Goodall, vice-president of the Institution, said that the need for more training facilities had become a major problem for modern industries. Younger men

n the electrical industry must not be forgotten and everything possible must be done to encourage further education. The North East was still a leading centre of the industry.

Mr. H. J. Stretton has been appointed director and general manager of G. D. Peters & Co., Ltd., and its subsidiaries.

Mr. G. W. Parkin, M.Eng., A.M.I.E.E., who has been appointed assistant (electric traction and generation), Mechanical and Electrical Engineer's Department, Derby, British Railways (London Midland Region), began his career on the former Mersey Railway at Birkenhead Central as a junior engineer in 1922.

After holding various positions he was appointed engineering superintendent in 1928 and continued in this position following the take-over of the Mersey Railway by the London Midland in 1951 until December last.

Mr. O. Thott, M.I.Mech.E., who since 1931 has filled the position of managing director of Boving & Co., Ltd., has been appointed vice-chairman of the company. He is succeeded as managing director by **Mr. D. A. Akins,** B.E., A.M.I.C.E., Mem. A.S.M.E., who has been with the company since 1934 and a director since the beginning of last year.

Mr. D. A. Akins

Mr. Akins was educated at Canterbury University College in New Zealand and joined the Wellington office of Boving & Co. in 1934. After two years in Wellington he was transferred to the Melbourne office and subsequently to the Indian branch. In 1939 he was transferred to the head office in London.

The Sports and Social Club of the **Eastern Electricity Board** (Essex Sub-Area, Millfield Section) held its fifth annual dinner and dance on 2nd April, at the Heybridge Country Club, Ingatestone, Essex, when 138 members and their guests sat down under the chairmanship of Mr. E. A. Cullen.

The following appointments are announced by the General Electric Co., Ltd., as deputies to **Mr. T. G. Travis,** sales manager, Witton Engineering Works: **Mr. J. F. Prince,** export sales, and **Mr. A. E. Taylor,** A.M.I.E.E., home sales. Mr. Prince has been in charge of plant export sales since 1930. Since 1946 Mr. Taylor has been assistant manager for Scotland.

The West of England Branch of the **Purchasing Officers' Association** held a dinner recently at the Royal Hotel, Bristol, in honour of a visit by the Association Council. Among those who attended were Mr. S. F. Steward (chairman, South Western Electricity Board), Mr. E. Stanley (hon. secretary, West of England Branch, P.O.A., and fuel purchasing officer, South Western Division, B.E.A.), Mr. H. H. C. Wood (president, P.O.A., and chief purchasing officer, Igranic Electric Co., Ltd.), Mr. J. J. Pritchard (chairman, West of England Branch, P.O.A., and chief buyer, Aircraft Division, Bristol Aeroplane Co., Ltd.) and the Lord Mayor of Bristol, Ald. K. Brown.

At a dinner of the West of England Branch of the Purchasing Officers Association. Front row (left to right), Messrs. S. F. Steward, E. Stanley, H. H. C. Wood, J. J. Pritchard, and Ald. K. Brown

Mr. S. McCracken, Assoc.M.C.T., M.I.E.E., manager of the Belfast sub-office of Metropolitan-Vickers Electrical Co., Ltd., has been appointed a director of Metropolitan-Vickers South Africa (Pty.), Ltd. Mr. and Mrs. McCracken sailed for South Africa on 25th March. Mr. McCracken has been with the company for nearly forty years. He joined British Westinghouse in 1915 and gained an M-V scholarship to the Manchester College of Technology. After being senior tester in dynamo test he joined the erection department and was engaged on contracts in India, Burma, Singapore, Russian Turkestan and Western Siberia. He was appointed sales engineer at the Belfast sub-office in 1934 and was promoted to manager in 1950. Mr. McCracken served as chairman of the Northern Ireland Centre of the Institution of Electrical Engineers during the 1950-51 session.

Mr. F. W. Cox, B.Sc.(Eng.), M.I.E.E., has been appointed manager of the Belfast sub-office in succession to Mr. McCracken. Mr. Cox took his degree externally at Manchester College of Technology and Royal Technical College, Salford. Following an apprenticeship at Ferranti's he went to Metropolitan-Vickers in 1935 and, after obtaining manufacturing experience in the instrument and meter department, spent several years in the drawing office and design sections of the motor engineering department. In 1945 he joined the general engineering department and in 1948 was appointed senior textile engineer. He was joint author of an I.E.E. paper "Electricity in the Cotton Industry," which was awarded the Crompton Premium. He is the present chairman of the Utilization Group of the North Western Centre of the I.E.E.

Mr. S. McCracken

Mr. F. W. Cox

The Council of the Television Society announces that the "Electronic Engineering" Premium has been awarded to **Mr. D. D. Jones** for his paper on "Transistors and Other Crystal Valves," and that the "Mervyn" Premium has been awarded to **Mr. G. J. Hunt** and **Mr. E. W. Elliot,** for their paper "An Introduction to the Sine Squared Pulse." All three authors are employed in the Research Laboratories of the General Electric Co., Ltd.

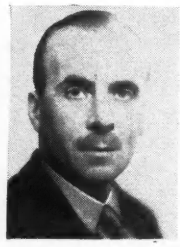
The new North Metropolitan Branch of the **Electrical Industries Benevolent Association** held its inaugural annual dinner and dance on 24th March at the Waterend Barn, St. Albans, about 150 members, friends and guests attending. The president of the Association, Sir John Dalton, and Lady Dalton, and Mr. H. S. Fothergill, secretary, were entertained by the chairman of the branch, Mr. C. C. Hill, and Mrs. Hill. A sum of £100 was raised for the funds of the Association.

OBITUARY

Mr. A. E. Hadley.—The death occurred on 8th April, at the age of eighty-three, of Mr. Arthur Edward Hadley, C.B.E., M.I.E.E., former chairman and managing director of the Victoria Falls & Transvaal Power Co., Ltd. In the early part of his career Mr. Hadley was in the laboratories of Ferranti, Ltd., Hollinwood, Lancs. During the 1914-18 war he was assistant controller of the Inspection Department, Ministry of Munitions. He had been a member of the boards of a number of companies, including the City of London Electric Lighting Co., of which he was at one

time deputy chairman. He became an associate of the Institution of Electrical Engineers in 1895 and a full member in 1912, and in the following year was awarded the Institution Premium for his paper on "Power Supply on the Rand."

Mr. E. B. Walden, director of Premier Electric Heaters, Ltd., died on 24th March, at the age of fifty-seven, after a long and painful illness. He joined the company in 1922 as buyer, later becoming sales manager. When the company became a member of the A.E.I. group of companies, Mr. Walden was made a director.



The late Mr. E. B. Walden

Mr. P. W. Turner.—The death occurred at Staines, Middlesex, on 6th April, of Mr. Percival Wilberforce Turner, A.M.I.C.E., M.I.E.E.

M. Auguste Lumière, well known as a pioneer of cinematography and later for his work in connection with medical photography, died at Lyons on 10th April at the age of ninety-one. With his brother, Louis, he was responsible for the perfection and commercial development of cinematography. He gave the first public performance in Paris in 1894.

WILLS

Mr. H. L. Bazalgette, A.M.I.C.E., M.I.E.E., former manager of the Hydro-Electric Department of the English Electric Co., Ltd., who died on 19th December last, left £10,335 gross (£10,227 net).

Mr. J. Hogan, lately export sales adviser to British Insulated Callender's Cables, Ltd., who died on 14th December last, left £6,058 gross (£5,639 net).

Mr. J. Lewis, a former joint general manager of the Marconi International Marine Communication Co., Ltd., who died on 9th February last, left £1,331 gross (£1,282 net).

Mr. A. Clements, formerly for over fifty years assistant secretary to the British Thomson-Houston Co., Ltd., who died on 26th October, left £21,252 gross (£21,165 net).

Mr. H. I. Yarwood, B.Sc., A.M.I.E.E., former chairman of the South Midland Radio Group of the I.E.E., and connected with Solenoids and Regulators, Ltd., who died on 28th February, left £13,497 gross (£11,635 net).

Mr. W. J. Crampton, electrical engineer, of Crampton & Co., Ltd., who died on 30th December, left £18,314 gross (£16,102 net).

National Poultry Show

The 9th National Poultry Show is to be held at Olympia, London, from Thursday to Saturday, 9th to 11th December, inclusive.

Chief Technical Assistants' Association

THE 39th annual dinner of the Chief Technical Assistants' Association was held in London on 9th April under the presidency of Mr. E. H. Jesty, A.M.I.E.E., chairman of the Association.

In proposing "The Chief Technical Assistants' Association" Mr. D. B. Irving, B.Sc., M.I.E.E., deputy chairman, London Electricity Board, expressed admiration of the way the members had maintained the Association in a changing world and reminded the company that the Association had been borne out of a proposed Bill to establish one supply undertaking alone for London. Now the Association was in fact an exclusive club based on personal friendship and nothing but good could come out of it. He paid tribute to the present chairman on the score both of his ability and amiability.

In reply Mr. Jesty referred to his close association with Mr. Irving, a chief who showed "exquisite tact" when administering the rebuke. He confirmed what Mr. Irving had said about the exclusiveness of the club and said that to-day they would welcome an application for membership from a chief engineer. The object of the Association was the interchange of knowledge in an atmosphere of friendliness.

Mr. J. R. Jones, M.I.E.E., former manager, North-Western Sub-Area, London Electricity Board, in proposing "The Supply Industry," referred to the efforts of politicians to get the supply companies and undertakings to "sleep together." Then 1948 gave the industry the greatest shock it had ever had. That year saw generation and distribution entirely divorced, but he was not sure that that was the right thing.

In replying to Mr. Jones' toast Mr. L. H. Welch, B.Sc., M.I.E.E., chief engineer, London Electricity Board, made some interesting comparisons between present conditions and those of the earliest days of the Association.

Mr. B. L. Wells, B.Sc. (Eng.), M.I.E.E., sub-area engineer, North-Western Sub-Area, proposed the health of the guests and Mr. A. N. D. Kerr, A.M.I.E.E., director, A.E.G. Electric Co., Ltd., replied.

Power Convention Programme

OVER 2,000 delegates representing the thirty-seven principal electrical organizations will attend the sixth British Electrical Power Convention at the Winter Garden, Eastbourne, from 14th to 18th June.

On the Monday evening, the president, Mr. J. R. Beard, will officially open the electrical exhibition to which the public will this year be admitted on Wednesday, Thursday and Friday up to 9 p.m. A civic welcome by the Mayor of Eastbourne on Tuesday morning will be followed by the Presidential Address and the E.A.W. luncheon at the Grand Hotel. In the afternoon a paper on "Electrical Engineering in World Trade," will be given by Sir George Nelson, chairman and managing director, English Electric Co., Ltd. Simultaneously there will be a ladies' tea at the Music Pavilion on the pier. A reception by the Mayor and Mayoress of Eastbourne is to be given in the evening.

Wednesday morning's programme includes: "Modern Lighting for Industry, Commerce and the Home," by Mr. W. J. Jones, director of E.L.M.A., and "Electricity in the Modern Home," by Dame Caroline Haslett, director, E.A.W. Both these papers will be accompanied by demonstrations.

Thursday morning's paper is on "The Development of the Domestic Electricity Load at Home and Overseas," by Mr. D. Bellamy, chairman, Yorkshire Electricity Board, while Mr. S. L. M. Barlow, president, E.C.A., will speak in the afternoon on "The Comparison of Installation Practice at Home and Overseas." The annual dinner and dance will be held in the evening.

An electrical forum will precede the annual general meeting on Friday morning.

Index to I.E.E. Proceedings

The ten year index to the *Proceedings* of the Institution of Electrical Engineers which has just been published covers the years 1942–51 and embraces not only the regular issues of the four Parts, but also the special issues, with their separate indexes, of Parts IA, IIA and IIIA, in which the papers presented at various important conventions were published. Like the annual indexes which are its foundation, the ten year index has an entry for every author in a group of joint authors, for every speaker in a discussion, and for every key word in the title of a paper. In addition, titles of papers are collected together under forty broad subject headings, thus forming small bibliographies on all the topics which are of interest to electrical engineers.

The ten year index measures 8½ by 5½in and contains 500 pages and 17,000 entries. It is obtainable from the secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2, price £1 5s post free (members, £1).

INDUSTRY AND THE HOUSE

Television Bill Second Reading Debate

By A. M. F. PALMER, A.M.I.E.E., M.P.

THE debate on the Second Reading of the Television Bill opened with an exchange between Mr. Speaker and Labour back benchers; Members wanted to know again if it would be in order for those of their colleagues who might have a direct personal pecuniary interest in commercial television to vote.

Mr. Frank Bowles, the Labour Member for Nuneaton, explained his point with some of the reflected authority that shines on him from being a former Deputy Speaker. He argued that a ruling applicable to the White Paper discussion needed to be looked at again now we had reached definite legislative proposals. Mr. Speaker replied that he thought there was nothing he could add to his previous ruling. By all the precedents it was quite clear that for an interest to constitute disqualification from voting it must be an interest personal to the Member concerned and not a matter of general policy; a matter did not cease to be general policy simply because it was embodied in proposed legislation. But Members were not easily satisfied; a whole series of supplementary points were put to Mr. Speaker with that persuasive ingenuity that excites always the amazement of those who attend a debate in the House for the first time.

In the end, all inquirers quelled, the House proceeded to listen to the Home Secretary, Sir David Maxwell Fyfe, moving the Second Reading of the Bill. It was not the intention of the Government, he said, that the new Independent Television Authority should enter into the programme-making business and build up a large organization of its own. The new authority while broadcasting the programmes would receive payments from contractors who would provide the programmes, these in turn would obtain their income from advertisers. There was no scope in the Bill for the authority to get rid of the programme contractors altogether and set itself up as a rival to the B.B.C.

Sir David's speech, which has spread itself into a little short of twenty columns of *Hansard*, was a detailed and at times perhaps over-painstaking explanation of a makeshift which has few friends left to bless it. In his final sentence the Home Secretary told the House that his " typically British compromise " was bound to have great difficulties but he was certain that it would achieve the Government's fundamental purpose—to give citizens the alternative television programme they wanted.

Mr. Herbert Morrison, for the Opposition, accused the Conservatives of being the champions of hidden monopoly; in spite of the superficial use of the word " competition," there was nothing anti-monopolistic in the television scheme. It would help big business which could afford expensive advertising and would hurt the small trader and manufacturer who could not. He charged the Government also with being an enemy of cultural standards in broadcasting and television.

The debate was continued by a series of Members, most with expert or special knowledge, until Mr. Ness Edwards and Mr. David Gammans wound up for the Opposition and Government respectively. Mr. Edwards, a former Postmaster General, said that they would fight the Bill line by line in Committee, and repeated Mr. Morrison's earlier warning that a future Labour Government would reserve the right to eliminate commercial advertising altogether from what he described as " an important medium for influencing men's minds."

Mr. Gammans, the Assistant Postmaster General, was greatly interrupted throughout his speech, but at last one technical point emerged: the two channels in band 3 which the Government proposed to allocate to commercial television would be sufficient, without any others, to give coverage to Wales and Scotland.

East-West Trade

Attention has been given in the House recently to trade with Russia, China and countries east of the Iron Curtain. There has been a general debate and last week Mr. Peter Thorneycroft, the President of the Board of Trade, was closely pressed by Mr. Harold Wilson, his predecessor in that office, to elaborate on his recent discussions with Mr. Stassen of the United States and M. Maurice Schumann for France.

The Minister said that they had discussed the scope and enforcement of the controls over the export of strategic goods to the countries of the Soviet bloc. They found themselves in full agreement that while controls must be maintained on exports of goods which might add directly to the military capabilities of potential enemies, it was right to seek the expansion of normal civilian trade. Mr. Thorneycroft assured Mr. Wilson and the House that the Government was anxious to avoid needless delay, but there must be further talks with other friendly Governments which were equally concerned.

Mr. Wilson's blunt reaction was that the statement might mean anything or nothing; he wanted to know whether within the agreement reached with Mr. Stassen it would be possible to do anything effective? He was left to whistle for a firm answer I am afraid. Support for more east-west trade is not, of course, confined to the Opposition side of the House. Many Conservatives are obviously keen on its development. Sir Walter Fletcher, for instance, was quick to make the point that Russia had shown herself able to do in a reasonable number of years practically everything she had set her hand to, the moral presumably being that if we could not supply the Soviets they would go elsewhere or supply themselves, leaving us the losers.

Atomic Energy Bill

The Atomic Energy Bill has now completed its Committee Stage " on the floor "; it is expected to have a very short Report Stage and Third Reading debate before leaving for the Lords. On the whole Mr. David Eccles has been helpful in accepting Opposition amendments; one gets the impression that the Bill has become rather less contentious between the parties since the time when it was first published. There was a useful small debate on the omission from the provisions for joint consultation of " efficiency " as a matter for discussion between manage-

ment and the trade unions. Mr. Eccles' explanation was that it was no oversight but a genuine concern for the security of atomic establishments. This was a weak argument because it was obvious to knowledgeable Members that the wording of the sub-section was identical with parallel sections in the nationalization Acts (apart from the exclusion of efficiency) and included all matters of " mutual interest." The Minister gracefully gave way to the logic of Opposition argument; he said that he would consider amending the Bill as suggested.

Vast and natural Press publicity has been given to the hydrogen bomb and its discussion in the House of Commons; it is at least comforting to reflect that the House is also considering in a quieter fashion further ideas for harnessing nuclear fission to the constructive purposes of peace.

Brazil Power Schemes

From Our Rio de Janeiro Correspondent

PRESIDENT VARGAS has signed two decrees granting important power concessions in Minas Geraes to Companhia de Electricidade Sao Paulo e Rio, one of the allied companies of Sao Paulo Light & Power Co., Ltd. The decrees in question authorize the progressive development of the hydraulic potential of the Paraiba River between Benjamin Constant and Simplicio and between Benjamin Constant and Tres Rios, with power stations of 200,000 and 400,000 kW, respectively, at Simplicio and Benjamin Constant.

The State of Espirito Santo has obtained a loan of 172 million cruzeiros (£3,436,000) from the Brazilian Bank for Economic Development to build a 24,000 h.p. hydro-electric station at Rio Bonito. This is one of a group of four planned for the Santa Maria Basin. The others are: Suiça, 170,000 h.p., Timbau Seco, 18,000, and Santa Leopoldina, 25,000. The State Government has already spent £830,000 on the Rio Bonito dam, which measures 280 by 8 by 34 metres, and on a 680 metre tunnel, cut through rock, to the power station, where three 8,000 h.p. turbines will be installed. The equipment is being imported from Germany.

The Ministry of Agriculture has approved the Bahia State Government's proposals for the progressive utilization of the hydraulic power of the Funil, Pancada and Pancada Grande Falls, with a total potential of 84,400 h.p. Electricity will be supplied to 30 municipalities within a radius of 200 km.

President Vargas has approved the emergency plan and estimates for developments in the Amazon Basin in 1954. The equivalent of £1,103,400 is earmarked for amplifying power supplies and investigating the hydraulic potential of various falls. The capacity of the stations at Belem, Manaus, Cuiaba, San Luis, Boa Vista and Nova Timbotena will be raised.

The Brazilian Bank for Economic Development is to advance 300 million cruzeiros (£6,000,000) to the Companhia Hydroelectrica do Sao Francisco to complete the first stage of its programme. Two 60,000 kW generators have been installed and preparations have been completed for a third unit of the same capacity; 861 km of transmission lines have been erected, from Paulo Afonso to Recife and Salvador, with 220 kV substations at Recife, Salvador, Angelim and Itabaiana. The secondary transmission system comprises 977 km of line.

In South Brazil, diversion of the Canoas River to supply 100,000 h.p. to the Pombas station in Santa Catarina is recommended. At the Sobragi Rapids, in Minas Geraes, where a difference of level of 70 m exists, the building of two 40,000 kW stations is suggested, while the power resources of the River Uruguay and the River Piloes may also be developed.

All the above are in the Parana Basin, where the total power potential is estimated at 7,053,000 kW. In the same region experts have studied the Negro and Negrinhos Rivers, capable of supplying 120,000 h.p., and the Dourada Falls, on the Parnaiba River, between Goias and Minas Geraes, where a total potential of 300,000 h.p. is available. Seven States are interested in increasing the installed capacity in the Parana Basin, which embraces a fertile zone of 1,158,000 sq miles with 27 million inhabitants.

Brazil's total installed capacity at 31st December, 1953, is officially quoted at 2,089,473 kW, of which 1,671,269 kW is of hydraulic and 418,204 kW of thermal origin. Hydro-electric capacity was increased by 73,190 kW in 1953 and thermal plant by 31,382 kW. Sao Paulo now has 862,350 kW of plant; Rio de Janeiro, 495,948 kW; Minas Geraes, 261,772 kW; Rio Grande do Sul, 104,866 kW; Pernambuco, 60,952 kW; and Parana, 15,536 kW. The country's total hydraulic potential is officially estimated at 16,456,445 kW, of which approximately 90 per cent is still unused.

The Piratininga thermal station now being built by the Brazilian Traction, Light & Power Co., will consist at the start of two 100,000 kW generators. The station, for which the World Bank advanced $U.S. 18·8 million in February, will be completed this year at a cost of $U.S. 35 million.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents

Electric Blanket Accidents

IN your journal of 26th March you reported a fatal accident at Oswestry, due to an electric blanket having been left switched on by the occupant of the bed. The report says:—

> " There was no electrical fault in the blanket, but if someone's body lay there with salt in perspiration, which was a good conductor of electricity, then it would be possible for the current to pass through the body as an alternative path to passing through the blanket. If the blanket was not fitted with a thermostat, it must be switched off. Police-Sergeant J. O'Reilly said Perry's clothing was saturated in perspiration. When he touched the body he received an electric shock."

It is unfortunate that such a report should tar all electric blankets with the same brush. Since 1948 all our blankets have had the elements and connections sealed in plastic insulation or mouldings, and even though (as sometimes happens) children or old people should wet the bed, with the blanket left switched on, no short-circuit condition can be set up through the liquid.

The statement about the thermostat is equally misleading. It is not correct that " if a blanket is not fitted with a thermostat it must be switched off." Obviously this has no connection whatever with the cause of the accident, because even if the blanket had a thermostat the man could still have been electrocuted. The facts about thermostats in electric blankets are (or should be) reasonably well known by now. (We will send a technical leaflet to anyone who is interested in the problem.) It may be sufficient here to say that the contemporary draft British Standard on Electric Blankets approves the omission of thermostats where the designed loading of the blanket is less than a certain maximum, which will probably be below 10 watts per square foot. We pioneered such a design in 1933.

F. GRISLEY,
Managing Director,
THE WARM-GLOW CO., LTD.

Leigh-on-Sea, Essex.

PARLIAMENTARY REPORT

IN the House of Commons last week Viscountess Davidson asked the Minister of Transport whether he would make a further statement upon progress with automatic train control arrangements on British Railways, having special regard to the report of H.M. Inspectors of Railways following the Harrow train disaster in October, 1952.

Mr. Lennox-Boyd said that the British Transport Commission was making vigorous efforts to develop the apparatus to the necessary standard of reliability and large-scale trials are now in progress, but it might still be some time before the Commission and the Chief Inspecting Officer of Railways were satisfied that the necessary standard had been achieved.

Fuel Efficiency Service

Mr. Philips Price asked whether the appointments had been made for the board of directors and staff of the National Industrial Fuel Efficiency Service, and when it was expected that operations would start.

Mr. Lloyd said that the directors, general manager and secretary had been appointed; staff recruitment was proceeding and the Service expected to start operating on 1st May.

Mr. Palmer asked the Minister of Fuel and Power to what extent he proposed to make available to the new Fuel Advisory Company details of private industrial processes, entrusted to his department by manufacturers and others, when his departmental fuel efficiency service was brought to an end and the new company took over.

Mr. Lloyd replied " None, sir."

Mines and Quarries Bill

Standing Committee A of the House of Commons, which is considering the Mines and Quarries Bill, last week agreed in principle to an amendment to Clause 68 (Electricity and Electrical Apparatus). Mr. Blyton pointed out that in the 1911 Act definite duties were placed on the manager and definite powers on the inspector that where there was over 1¼ per cent gas in the air of a coal pit the electric power had to be switched off. But the present clause did not indicate that the minimum standards embodied in the 1911 Act safeguarded the men in the pit against electricity being used if there was more than 1 per cent of gas in the general body of the air. They did not want to be worse off than they were under that Act in relation to the use of electricity. His amendment provided that they would have the minimum standard and that electricity should not be used until the area was once more freed from the gas.

Mr. Geoffrey Lloyd, the Minister of Fuel and Power, said that under the Bill they wanted not only to keep the standards of the previous Act, but to improve on it. He appreciated Mr. Blyton's desire to make quite sure about the minimum; he accepted the principle of the amendment and would put it into appropriate words on the report stage.

On that understanding the amendment was withdrawn.

Cost of Fuel and Transport

Mr. Osborne asked how much of the recent fall in the internal purchasing power of the £ was due to the increased cost of coal, gas and electricity, and higher transport charges.

Mr. Maudling, Economic Secretary to the Treasury, said that of the estimated fall from 20s to 19s 2d between October, 1951, and February, 1954, about 2d could be attributed to increases in the cost of fuel and light and in fares.

M.P.s' Electric Fire

Mr. Bullard asked the Minister of Works whether he was satisfied that the electric fire provided in the Members' Smoking Room of the House of Commons was equipped with a guard that was in accordance with the regulations issued under the Heating Appliances (Fireguards) Act, 1952.

Mr. Bevins said that the electric fire was purchased by the Department before October, 1953, when the regulations about fireguards came into force. It was installed at short notice during a severe cold spell as a temporary means of supplementing the central heating and it would shortly be removed.

Uganda Electricity Board

Asked by Mr. Sorensen what was the present composition of the Uganda Electricity Board, Mr. Lyttelton, Secretary of State for the Colonies, said the Board comprised Mr. C. R. Westlake (chairman), the Financial Secretary (or his representative), Mr. H. R. Fraser, C.M.G., O.B.E., Mr. A. N. Maini, C.B.E., Mr. C. Handley Bird, Mr. S. S. Tindall, C.B.E., Sir Douglas Harris, K.B.E., C.S.I., C.I.E., Mr. C. C. Spencer, C.M.G., and Mr. B. K. Mulyanti, M.B.E. Members were appointed for such period as the Governor-in-Council directed: the term of office of the present members was three years, expiring in 1957.

Neon Lighting in Shops

Replying to Mr. Sorensen, the Minister of Transport (Mr. Lennox-Boyd) said he had received very few complaints about glare from neon lighting in shop windows. In view of the lack of evidence of any material danger to road users he would not feel justified in taking action to encourage the use of shields as suggested.

I.E.S. LIVERPOOL CENTRE

THE importance of chemical engineering in formulating industrial policy was stressed by Sir Harold Hartley, deputy chairman, Electricity Supply Research Council, in an address at the annual luncheon meeting of the Liverpool Centre of the Illuminating Engineering Society at the Adelphi Hotel, Liverpool, on 5th April. Mr. W. Gilchrist presided.

Sir Harold said he attached great importance to chemical engineering because the industrial future of this country largely depended on work in this field. The chemical engineer was complementary to, and not in competition with, electrical, mechanical and civil engineers. The statement had been made that technicians were people who had failed to reach the standards required by pure science. The implications of such a statement were quite wrong, for engineers translated the work of the pure scientist into its practical applications. To-day, the future of the world depended to a large extent on what the engineers could do for it. It was in the two fields of scientific process and the production of synthetic materials that chemical engineers had found scope for action. Sir Harold said that when the chemical engineer and his research staff had devised the most economical method of carrying out various processes, the time arrived for the other classes of engineers to apply their skill and knowledge. The community did not appreciate the great strides that had taken place in illumination during the past seventy years.

Other guests included Mr. W. R. Stevens (president, I.E.S.), who proposed the toast to the " City and Port of Liverpool," and the Lord Mayor of Liverpool (Ald. W. John Tristram) who replied.

Public Speaking Competition

Ten men and nine women will compete for the Faraday Challenge Shields in the national finals of E.D.A.'s public speaking competition at the Lighting Service Bureau, 2, Savoy Hill, W.C.2, on 23rd April, the women at 10 a.m. and the men at 2.30 p.m.

INDUSTRIAL NEWS

National Physical Laboratory

OWING TO THE continuous development of techniques for the examination of the fine structure of metals and the growth of interest in the properties of metals at very high temperatures it has been necessary to extend the premises of the National Physical Laboratory at Teddington. The new building was officially opened on 6th April by Professor Sir Lawrence Bragg, O.B.E., M.A., D.Sc., F.R.S. It consists of a two-storey building on the west side of Bushey Road to the north of the Wernher building and has a total floor area of about 11,700 sq ft of which about 5,800 sq ft is experimental working space. Its purpose is to accommodate three sections of the Metallurgy Division: the ceramics section, the X-ray section and a new radioactive tracer section.

Engineering Wage Offer Accepted

Representatives of the constituents of the Confederation of Shipbuilding and Engineering Unions meeting at York on 8th April decided to accept the employers' offer of increased wages. The weekly additions amount to 8s 6d for skilled workers, 7s 6d for semi-skilled men and 6s 6d for unskilled. About three million people are involved and the annual cost has been put at £50 million.

Representatives of the two general workers' unions expressed dissatisfaction that the increase in rates for unskilled workers was not greater.

Catering Equipment Exhibition

M. Jean Conil, the well-known chef, told Blackpool caterers that electricity was the answer to kitchen problems when he spoke at the opening of an electrical catering exhibition organized by the North Western Electricity Board in the Jubilee Theatre, Blackpool, from 31st March to 6th April. The exhibition, promoted especially so that seaside hotel and boarding house keepers and caterers could see the large range of electrical equipment available to them, was opened by Mrs. H. Charlesworth, president of the National Federation of Boarding House Associations. Mrs. G. D. Dakin, chairman of the Blackpool Branch of the Catering Association of Great Britain, presided. Speakers included Sir Joseph Hallsworth, chairman of the Board, Mrs. Gloria Swanson, president of the Blackpool Hotel and Boarding House Association, and Mr. W. Rees Jones, head of the Hotel and Catering Department of the Blackpool Technical College.

The exhibition had two model kitchens as its main set-pieces, one containing equipment suitable for a boarding house taking 50 to 75 guests, and the other for an hotel catering for 250 to 300 guests. Equipment to be seen in the model boarding house kitchen included a double oven range, single pan fryer, a potato peeler, a 20 gal cistern type water heater, an instantaneous water boiler, a hotcupboard and bain marie, a dishwasher, a mixer, a griller toaster, and a refrigerator. Similar equipment with some variation in size was found in the hotel kitchen, as well as a potato masher, potato chipper, two hotcupboards with a bain marie and carving well, a café set, 16 gal stockpot, a meat slicer, a single deck pastry oven, and a mixer mincer.

Trade with Mexico

The Mexico City correspondent of *The Times* says that at a Press conference in that city on 7th April Sir George Nelson, chairman of the English Electric Co., Ltd., who, with Lady Nelson, is making a tour of Latin America, said that considerable potentialities existed for the exchange of Mexican metals and cotton for manufactured products, particularly capital goods. He thought that British technical excellence and scientific advances could make a major contribution to Mexico's expanding industrial economy.

He referred to British leadership in the development of radar, television, diesel engines and communications and said that spare parts from Canadian factories could readily supply the Mexican market equalling the rapid service given by American exporters.

Sir George advocated a freer exchange arrangement to enable more Mexicans to take advantage of British education and research.

Higher Australian Duties

The Times reports that on the recommendation of the Australian Tariff Board, higher duties have been imposed on certain imported electrical circuit breakers and switch units in the higher voltage ranges to which local manufacture has been extended.

Snowy Mountains Contract

It was announced from Canberra last week that the American Kaiser-Walsh-Perini-Raymond group had secured the contract, valued at about £A25 million, for work on the Snowy Mountains hydro-electric scheme. The contract involves the construction of a 14-mile-long tunnel 21ft in diameter to divert the water of the Snowy River system from the Eucumbene River to the Tumut River. At Tumut the group will build a 280ft high concrete dam and a pressure tunnel three miles long. It is stated that no tenders for the work were received from British companies.

Orders for two water turbines have been placed with the English Electric Co., Ltd., and for two generators with the Australian subsidiary of the A.S.E.A. (Sweden).

Chalk River Reactor

The Ottawa correspondent of *The Times* says that the Canadian Government's heavy water reactor at Chalk River atomic research station, near Ottawa (dealt with in our issue of 12th March) is in operation again after having been closed for 14 months because of an accident in December, 1952. The reactor has been reconstructed as well as repaired, and its operating power has been increased from 30,000 to 40,000 kW. When the reactor first began to operate in 1947 it was designed for steady operation at 10,000 kW, which has been increased by a series of modifications, the latest of which is regarded as an important scientific achievement the main result of which will be that many research experiments and the production of radioactive isotopes will need less time than before.

Submarine Cable for Canada

Following the recent announcement that British Insulated Callender's Cables, Ltd., has received an order valued at over $3,000,000 from the British Columbia Electric Co. for the supply and installation of submarine electric cable, it is now learned that the construction of some of the special cable making plant to be installed at Trafford Park for the manufacture of the cable has been entrusted to B. & F. Carter & Co., Ltd., Bolton.

The Glover 138 kV gasfilled type cable will be laid across the Georgia Strait from the Canadian mainland to Vancouver Island and, it is claimed, will have a higher carrying capacity and voltage than any similar installation in the world.

Electronic Computer Order

A large new £100,000 electronic computer has just been ordered by A. V. Roe, Ltd., makers of the Vulcan bomber aircraft, from Ferranti, Ltd., and in announcing this Sir Roy Dobson, managing director of A. V. Roe, claimed that Avro was the first British aircraft firm to purchase this modern brainwork-saving equipment for its own use.

The computer is scheduled to be installed some time in the autumn this year. It will lighten the heavy burden of routine arithmetic for Avro's design and research staff by mechanizing their vitally necessary work. In modern aircraft design it becomes a major

operation to complete the calculations fast enough not to delay production, and new designs progressively demand speedier mathematical investigation as aircraft fly higher, faster and farther. It will speed up the process of reconciling physical possibilities of aircraft with the theoretical demands for performance, airworthiness, strength, weight and stowage of loads. Aircraft vibration, delta wing mathematics, and stability calculations are among the problems which will be dealt with.

Birmingham Engineering Centre

All the exhibition space at the new Birmingham Exchange and Engineering Centre has now been taken. The 200 firms who will be exhibiting include a large number of electrical concerns.

The Exchange, which will be opened in June as Britain's only permanent engineering centre, already has a waiting list of firms wishing to exhibit.

A wide variety of medium and light engineering products will be on view and the stands are already being equipped.

Colliery Plant Order

An order has been received by the Fraser & Chalmers Engineering Works of the General Electric Co., Ltd., from the National Coal Board, South Western Division, for a Chance coal preparation plant for the Onllwyn Group of Collieries in the Division's No. 9 Area. The order includes electrical equipment for pumps, crushers and conveyors together with the electrical equipment necessary for the small coal washery and for the run-of-mine screening plant which is being supplied by the Norton-Harty Engineering Co., Ltd.

Bradford Electrical Exhibition

On Saturday last Ald. R. Barber, chairman of the Bradford Education Committee, opened an "Electricity in the Home" exhibition at Bradford Technical College, in which over forty manufacturers are co-operating to show the public the modern electrical equipment now available. Apparatus on show includes water heaters, radiators, washing machines, refrigerators, dishwashers, gardening equipment, portable tools, and lamps.

Television Studio Equipment

The B.B.C. announces that it has placed contracts with Marconi's Wireless Telegraph Co., Ltd., Electric & Musical Industries, Ltd., and Pye, Ltd., for new television cameras, picture monitors and other equipment for studio use. The Marconi contract covers the provision of sixteen cameras using the 4½in "Image Orthicon" pick-up tube developed for studio use, the associated camera channel apparatus, six vision mixing and preview switching equipments, distribution amplifiers and waveform generators. E.M.I. will supply seventeen cameras of the improved "C.P.S. Emitron" type and the associated camera channel equipment. The Pye contract covers the provision of sixty-two picture monitors. This equipment will be used to re-equip some of the existing television studios and to extend studio facilities in the London area.

The modernized showrooms of the South Eastern Electricity Board at Crowborough, the opening of which was reported in our issue of 2nd April

Electricity and Clean Food

Arranged by the Women's Public Health Officers' Association, a special course on domestic, social, and industrial hygiene was held at Queen Elizabeth College, Campden Hill Road, W.8, from 2nd to 10th April. In connection with the course a special exhibition entitled "Electricity's Fourteen Points for Cleaner Food" was staged by the Electrical Development Association at the College and one session was reserved for the presentation of electrical ways of ensuring cleanliness.

Cable & Wireless Jubilee

Great developments in international telegraphy are foreshadowed by Major-General L. B. Nicholls, chairman of Cable & Wireless, Ltd., in a booklet issued on 8th April. The booklet, entitled "World Wide Communications," is issued by the company to commemorate the silver jubilee of its incorporation. It recalls that the company was formed in 1929, under the name of Imperial and International Communications, Ltd., and was changed to Cable & Wireless, Ltd., in 1934, as a result of the Empire Wireless and Cable Conference held in London in 1928. The Conference resulted in the merging of the cable services of the Eastern and Associated telegraph companies, the Marconi Co.'s telegraph services, and certain cable and radio services operated by the British Post Office and Pacific Cable Board. Between 1947 and 1952 the Governments of the United Kingdom, Canada, Australia, New Zealand, South Africa, India, Southern Rhodesia and Ceylon acquired the assets of the telegraph services which Cable & Wireless, Ltd., and its associated companies had previously operated in their territories.

The services which the company now operates directly or through associated companies include external cable or wireless services in more than twenty countries in Europe, Asia, Africa, South America and the Caribbean, and external cable or wireless services in most of the Crown Colonies. It owns the 150,000 miles Commonwealth submarine cable network which it maintains by means of a fleet of eight cable ships. It employs a staff of about 9,000 comprising over fifty nationalities, working at 132 overseas stations and offices.

Professional Engineering Appointments

During 1953 over 7,600 engineers were submitted by the Professional Engineers' Appointments Bureau for vacancies notified in civil, mechanical and electrical engineering. The Bureau, which was set up in 1945, is directed by a joint board composed of members nominated by the Institutions of Civil, Mechanical and Electrical Engineers, serving in their individual capacities. Employers may notify any vacancies occurring in their companies without being under any financial obligation to the Bureau, but when a Bureau nominee is accepted by an employer a charge is made equivalent to 1½ per cent of the engineer's gross annual salary.

In electrical engineering, vacancies in the light current field predominated last year and engineers with experience in electronics were relatively easy to place. Industry is looking for large numbers of experienced engineers in this field and provides openings for young candidates for training. The Bureau conducted several hundred interviews with employers and electrical engineers of all ages and by this personal

service was able to satisfy many requirements, although it is felt that considerable benefit would result from increased notifications by electrical employers of vacancies they have to offer.

The problem of placing the older engineer is still acute, except in the case of senior appointments requiring wide experience and the ability to undertake heavy responsibility. Many more engineers could have been placed by the Bureau if suitable living accommodation had also been offered. There also appears to be increased reluctance on the part of younger engineers to make their careers abroad. Possession of a university degree is, in many cases, the main factor in deciding whether an engineer should be interviewed, often irrespective of experience.

Electricity on the Farm

A revised edition of "Electricity on the Farm," which was first published in October, 1947, has been issued by the British Electrical Development Association. The book, after explaining the economics of electricity supply and what a unit of electricity will do, describes the many tasks to which electricity can be applied on the farm, and includes chapters on equipment in the barn and farmyard, crop drying, milk production, poultry and egg production, and pig rearing. Such miscellaneous applications as irrigation, electric fencing, ventilation, etc., are also dealt with. There is a chapter on the planning and maintenance of electrical installations, and some of the many domestic uses of electricity in the farmhouse and cottage are described. The booklet can be obtained from the Association, 2, Savoy Hill, London, W.C.2, at 1s 3d.

Cable Impregnation Control

The Addison Electric Co., Ltd., London, has recently completed a new cable impregnation control station, shown in the accompanying picture. This equipment, which is destined for a large new cable works in Yugoslavia, was designed in co-operation with the General Engineering Co. (Radcliffe), Ltd., which is supplying the impregnating plant. It comprises ten electronic impregnation recorders.

Cable impregnation control equipment for Yugoslavia

Brush Sales Conference

The second biennial export sales conference of the Brush group of companies was held at Wadham College, Oxford, from 7th to 10th April. The conference was attended by representatives of the group's associated selling companies abroad, together with overseas directors and home based travelling executives. Its main object was to ensure that the overseas sales staff was kept in close touch with sales policy and technical development. Whilst in England the overseas staff is visiting each of the factories in the group. The conference was opened by Mr. Miles Beevor, managing director of the Brush group, who said that however good arrangements were for the circulation and exchange of information between the headquarters and overseas sales representatives, there was no real substitute for personal exchange of views. Mr. Beevor discussed the main sales considerations, quality, delivery, and price, coupled with long term credit.

F.B.I. Report

The annual general meeting of the Federation of British Industries was held on Wednesday last. In its report for 1953 the Federation reviews its wide range of activities both at home and overseas. Such matters as fuel and power, transport, patents and trade marks, iron and steel, industrial research and education are covered.

Dealing with fuel and power, the report refers to the setting up of the joint sub-committee of the B.E.A., the National Union of Manufacturers and the Federation to examine the technical problems of the operation of privately owned generating plant in parallel with the public supply. The Electricity Panel of the F.B.I. Fuel and Power Consumers' Policy Committee proposed a basis on which tariffs for stand-by supplies might be calculated. The Authority and Area Electricity Boards agreed in general with the Federation's suggestions and recognized the need for some rationalization of stand-by terms. Following the discussion with the Industrial Tariffs Sub-Committee of the B.E.A. in December, 1952, the F.B.I. submitted a memorandum on industrial tariffs. As a result the Area Boards promised to consider the provision of more steps in the unit charge as a concession to the high load factor consumer, and also adjustments in the fuel increment for high and medium voltage supplies.

Following representations, more industrial representatives have been appointed to Electricity Consultative Councils, and there are now fifty-seven instead of thirty-seven on these Councils.

New London Showrooms

Chilton Electric Products, Ltd., has opened offices and showrooms at 19, Old Queen Street, London, S.W.1. In a modern setting the company now has on view both the "Buk" and "Kub" electric shavers and also its miniature circuit breakers, earth leakage trips, distribution units, etc. Special prominence is given to the new core balance earth leakage circuit breakers, in which the earth leakage protection relies on the out-of-balance earth leakage current operating a protective circuit breaker.

Catalogues and Lists

Pressed Steel Co., Ltd., Cowley, Oxford.—Illustrated leaflet giving information about the new "Prestcold" unit coolers types UC.120 and UC.170.

Hotpoint Electric Appliance Co., Ltd., Peterborough, Northants.—Illustrated folder on the Hotpoint clothes dryer and a general price list.

The Wellman Smith Owen Engineering Corporation, Ltd., Darlaston, South Staffs.—36 p. illustrated catalogue on "Ross" valves for the control of single and double acting air cylinders, together with price list.

M.E.A.C., Ltd., 21, Newman Street, Oxford Street, London, W.1.—Priced folder illustrating the "Mastergrill" infra-red contact electric griller.

Linealux, Ltd., 142, Liverpool Road, London, N.1.—Illustrated priced catalogue of the "700" series of lighting and decorative fittings.

M.K. Electric, Limited, Wakefield Street, Edmonton, London, N.18.—Priced folder illustrating the company's range of industrial accessories (225), and a folder relating to new fused spur-boxes (226).

Burgess Products Co., Ltd., Team Valley, Gateshead, 11.—Five data sheets relating to "Burgess" microswitches for the company's booklet entitled "Recent Microswitch Developments."

Trade Announcements

The new address of the Bristol Office of the **Hotpoint Electric Appliance Co., Ltd.,** is 1, 3 and 5, St. Stephen Street, Bristol (telephone: Bristol 28606). The service depot is at Building 75, Whitchurch Airport, Bristol (telephone: Bristol 26451; Ext. 331).

A new showroom, stores and technical advisory service will be opened on 21st April by the **Wandleside Cable Works, Ltd.,** at 30, Tottenham Street, London, W.1 (telephone: Museum 1838).

Ekco-Ensign Electric, Ltd., has opened new offices, showroom and depot at 68, Caroline Street, Birmingham, 3 (telephone: Central 2997).

RADIOCHEMICAL CENTRE

New Buildings Opened at Amersham

ON 8th April Sir Henry Dale, O.M., F.R.S., past president, British Association, officially inaugurated new buildings at the Radiochemical Centre at Amersham. The Centre was created in 1946 and in 1950 it became a branch of the Atomic Energy Research Establishment, under the general direction of Sir John Cockcroft, and as such still it is, of course, a component of the Department of Atomic Energy.

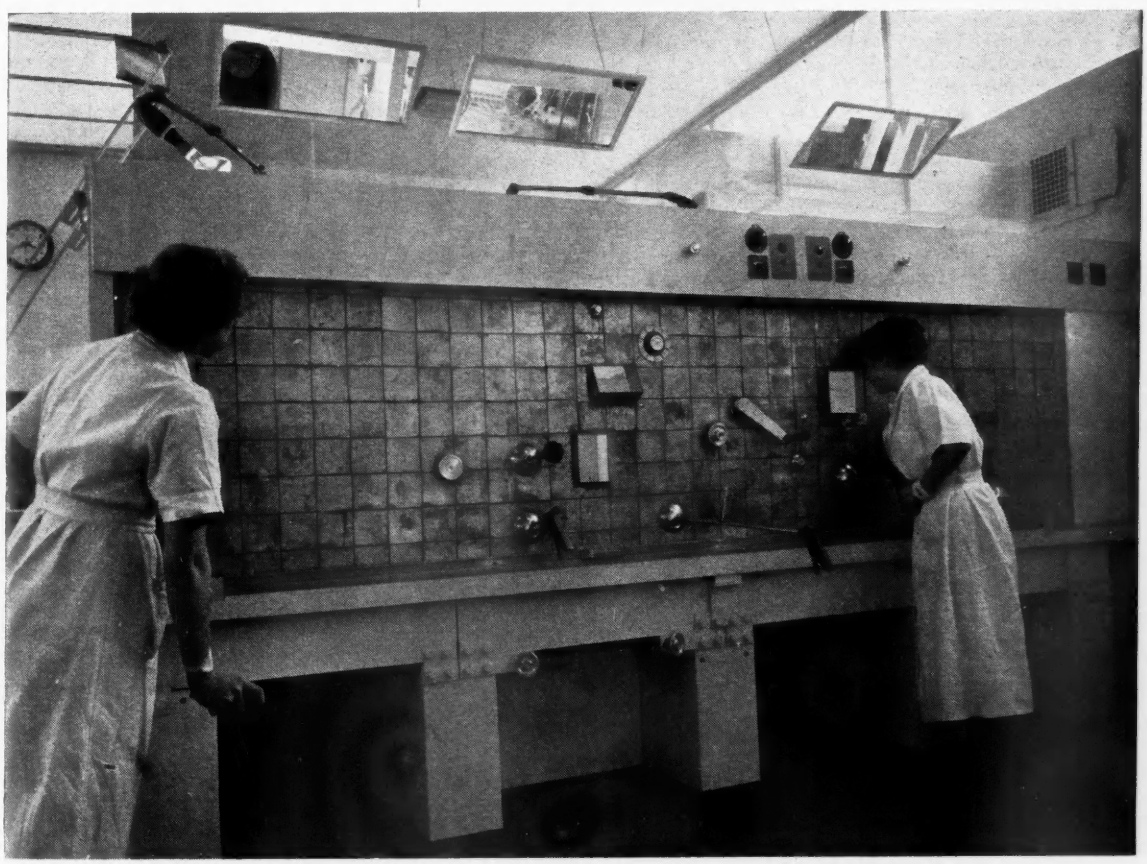
Until five years ago all the work at Amersham was with the natural radioactive elements, and there is still considerable academic interest in the elements themselves, the medical requirements of radium appliances and radon seeds having increased. But to-day, said Dr. W. P. Grove, head of the Centre, at an inspection of the extensions, their job was to collect the by-products of the manufacture of atomic energy and process them so that they could be used in industry, and a second line of development resulted from users wanting the material in a great variety of forms. Thus they had to make replicas of compounds incorporating radioactive properties.

Dr. Grove's comments were supported by what we heard during a tour of the Centre. The staff were insistent that they were actually manufacturing chemists or biochemists, the only departure from the normal being the remote control of handling the products throughout the processing of the materials and the screening of these from the personnel on account of the dangers of radioactivity. All the paraphernalia of distillation, precipitation, dispensing, etc., behind thick walls of lead blocks, can be seen either through very thick glass blocks in the screening walls or reflected in overhead mirrors.

The expansion scheme provides for eight buildings, and four of these have so far been erected. Each building is being used for a group of processes of similar character. One is engaged in the separation of fission products; in another are produced radioactive iodine, phosphorus, and other isotopes; the third is used as a dispensary for radioactive solutions; and the fourth is employed for biological processes.

Each building consists of a single room having a floor area of 900 sq ft, which is clear of any permanent fittings. The four buildings are well separated from each other, so as to reduce the radiation field between them and to allow access for heavy vehicles carrying supplies of radioactive raw materials. Each building is provided with all the services necessary for conducting radioactive processes

The distillation, precipitation, dispensing, etc., processes behind thick lead walls can be seen through block windows and in overhead mirrors



efficiently and safely—particularly ventilation and special drainage for radioactive effluent—and these are arranged to serve six production units in each room.

The installation of the chemical production plants has been going on for about six months and is nearly half completed. Five units are in operation. The processes which have been used hitherto for separating radioactive isotopes from irradiated materials have not generally been found suitable for scaling up, and it has, therefore, been necessary to develop new methods which are basically suited to operation by remote control. The products of the Centre fall broadly into two classes: radiation sources and radioactive chemicals (" labelled compounds "). There is a great variety of these materials, some twenty different isotopes and several hundred compounds, which are listed in the catalogue " Radioactive Materials " published in 1953.

The most versatile single isotope is radioactive carbon—Carbon-14. This is made by irradiating nitrogen with neutrons. The target material (aluminium nitride) is prepared at Amersham, sealed in aluminium cans, and sent to the production piles at Windscale to be irradiated for about a year. The active material is then returned to Amersham and Carbon-14 extracted from it. Owing to the long period of irradiation and the need for devising a target material which will withstand the rigorous conditions in the pile for that period, the building of stocks of Carbon-14 has been a laborious process; the annual production is now sufficient to meet the demand (about 10 curies p.a.).

About a dozen other " separated isotopes " are being made in routine, usually by extraction from materials irradiated in B.E.P.O. at Harwell, but occasionally also by cyclotron irradiation. Fortunately the two isotopes in greatest demand for medical purposes, Iodine-131 and Phosphorus-32, can be used in the simple chemical form in which they are first extracted; but the general trend is towards supplying each isotope in a variety of chemical compounds, comparable with the normal range of chemical laboratory reagents.

Waste solutions of fission products from which the plutonium and uranium have been removed are received at Amersham from the production factories in the north of England, and these are the raw materials from which several important isotopes are separated.

The value of materials supplied from Amersham during last year was £114,000, which is a little more than three times as much as in 1949. About one-third of the sales was exported, consignments being made to thirty-six countries.

Employment of Transistors

Four Papers Discussed at I.E.E. Meeting

A KEEN discussion followed the presentation of the four papers on various aspects of transistor design and operation at a joint meeting of the Radio and Measurements Sections of the Institution of Electrical Engineers on 7th April, reported in the *Electrical Review* of 9th April.

Dr. J. R. Tillman (G.P.O.), opening the discussion, referred to the measurement of small-signal parameters of transistors and made a plea for more consideration to be given to the choice of the parameters to be measured and to the means of measurement. As for the small-signal applications the junction transistor was at least as important as the point-contact unit, and he desired his remarks to refer to both types. In the small-signal field a choice might have to be made between several sets of parameters. There were the traditional ones which were closely allied to the impedance parameters of a four-pole network. Those were fairly well linked by the device designer. Then there were those, as yet not agreed upon, which were most easily measured. Finally there were those, also perhaps not agreed upon, which were of most value to the circuit designer.

Efforts had been made to extend the original parameters to meet all requirements, but some American opinion seemed to have moved away from them. If there were to be a common testing for point-contact and junction units, the hybrid parameters seemed to be preferred. The hybrid parameters could be used directly in some matrix analyses but in others they might need to be converted to the admittance parameters. They were probably the easiest to measure, requiring as they did no open-circuit collector and hence no difficulties when r_c was large and there were no short-circuited inputs and hence no risks of instability with point-contact units. They could be converted to the T-network referred to in the papers without much difficulty.

How were they to be measured? Bridge measurements would no doubt play some part, but a 1 kc/s scheme could do no more than give the real parts of the parameters. Circuit designers would often need to know much more, and difficulties arose with wide-band bridges. Instead, measurements of currents and voltages might have to be made. Any loss of accuracy would in general then be made up for by increased flexibility. Sweep methods covering bandwidths of several megacycles must be contemplated if the circuit designer were to have all the data he required. Phase measurements would also be necessary if the passage of minority carriers through a base region did not allow of adequate representation by minimum phase-shift networks. A third method of measurements, using rectangular pulses or steps and recording responses, might repay further study and prove economical for some users.

Dr. R. C. G. Williams (Philips) referred to the point-contact transistor and to the junction transistor and said in the case of the former there were the alarmingly small clearances with which to deal, whereas in the latter type there seemed to be possibilities not only of dealing with the clearances in more elegant ways by using the laws of physics, but also a greater opportunity of getting rid of heat. The papers dealt in the main with the point-contact transistor, and whether the work described would continue to be carried out on that type of transistor remained to be seen; but he shared the view that the junction transistor held out considerable possibilities. It was, of course, true that the point-contact transistor was a very serious competitor to the valve in switching devices.

Work on transistors was as yet in its early stages and the hard work of academic research, production development and application engineering had now to be faced. The brief honeymoon in which it was thought that all problems would

be solved for all time by transistors was recognized to be at an end not only in this country but also in the United States. The four papers were excellent examples of the steady serious study which had to be carried out in order to explore that field.

Mr. D. D. Jones (G.E.C.) said that reference was made to the question of measurement, and in his view it was essential not to expect all the users to have large racks and so on of test equipment in order to look at various characteristics. The finer points of measurement should be left to solving such circuits as those described by Mr. Cooke-Yarborough. For general circuits the manufacturers should provide adequate limits for the design of circuits.

Mr. Cooke-Yarborough mentioned the possibility of a transistor with more than one emitter. He wanted to put another point-contact on to an already rather complicated mechanical assembly. That, in Mr. Jones's view, would be a great pity because it was possible to make diodes which would fit the bill quite adequately.

Mr. T. H. Walker (S.T. & Co.) said that he had been working on grounded emitter type trigger circuits using point-contact transistors and had found them particularly useful from the viewpoint of power economy. In a typical static register the defined current method required about 0·5 W per stage whether the circuits were "on" or "off." He showed a slide illustrating two stages of a register which used grounded emitter circuits having finite collector loads and in which the power consumption was less than 55 mW for an "on stage" and less than 20 mW for an "off stage."

Mr. Bainbridge-Bell referred to the question of symbols for transistors and to the comment which was frequently made that the transistor got lost unless a circle was put around it. He asked whether the transistor got lost rather because the diagrams used the American convention of drawing all lines of the same thickness. The objection to a circle round the transistor was that endeavours were being made to retain the circle for an envelope. Therefore, if an envelope were used for something which was naked one possible self-evident symbol was lost.

Dr. Hartshorn said that a comment made by Dr. Tillman had shocked him a little. It was to the effect that the bridge method was not flexible enough, and that Dr. Tillman thought that movement would be in the direction of the voltmeter and ammeter methods. It was difficult to think of anybody who would measure resistance with an ammeter or voltmeter method when it could be done by the bridge method.

Dr. Tillman went on to say that because the authors used audio frequencies they could not obtain the other parameters which might be required. Although he was prepared to believe that those parameters might be wanted, Dr. Hartshorn said he still felt that it could be done by audio frequencies. In his view there was no inherent limitation in the use of audio frequencies.

Dr. D. Taylor referred to a remark which had been made that the transistors used very little power compared with other methods and that, therefore, they might have a rather wide application on that score, and said that it did not necessarily follow. On one occasion when he wanted a scaling circuit for an application in which it was necessary to exercise economy so far as the power supply was concerned (he wanted to use very small batteries) Mr. Cooke-Yarborough and his colleagues offered him a decade scaler for which the power supply required would be 1 W per decade. After making further inquiries in the field of gas filled tubes he was offered an apparatus which was not much bigger and which used only 0·3 W per decade. Therefore, it would appear that there was still life in the gas filled tube for the same application.

Mr. D. A. Bell, Mr. P. P. Eckersley and Dr. James also briefly contributed to the discussion.

NEW BOOKS

Electricity & Magnetism. By Edson Ruther Peck. Pp. 476; figs. and index. McGraw-Hill Publishing Co., Ltd., McGraw-Hill House, 95, Farringdon Street, London, E.C.4. Price 60s.

This volume is primarily intended for physicists and mathematicians with little knowledge of electrical and magnetic phenomena, and in this it is an excellent book. Starting from definitions using vector algebra, electrostatic field and dielectric theory is developed. Poisson's and Laplace's equations are proved, but little complex number or conformal transformation is attempted. Electric current theory is approached via the current density vector, giving the continuity equation div $\mathbf{J} = -\frac{\partial \rho}{\partial t}$ etc.; this is unusual to the electrical engineer, but, none the less a change. Direct current circuits lead to steady-state magnetization, electromagnetic induction and magnetic properties of matter. Transient currents are not, perhaps, so well explained. For example, the discharge of a condenser into an inductive resistor is solved by analogy with the equation of motion of the pendulum. Furthermore, the Heaviside operator is omitted, the chapter on a.c. circuits is mostly composed of complex numbers and vector representation, while only a few pages are given to the a.c. generator and transformer. The final chapter includes Maxwell's equations and the theory of electromagnetic waves. Problems are given at the end of each chapter, with some answers.

To the electrical engineer, this book is unusual in approach and students may gain much in the novelty. However, the standard of mathematics is such that its usefulness, except at advanced degree level, is very doubtful.—E.H.S.

The Royal Society of Arts, 1754-1954. By Derek Hudson and Kenneth W. Luckhurst (411 pp., 40 plates). John Murray, Albemarle Street, London, W.1. Price 30s.

In a foreword to this interesting history of the Society, the Duke of Edinburgh (the President) says that "by active origination, practical example and wise exposition it has led the way for two hundred years towards advancement in many familiar and practical aspects of life." The authors have made their selection from the voluminous transactions of the Society in such a way as to illustrate the truth of this statement; indeed it shows the surprising number of ways in which the Society has fostered invention, art and industry.

Mention is made of some early electrical devices and in a chapter on "The Amenities of Life" the Society's assistance in the development of the electric telegraph, telephone and radio and the electricity supply industry is dealt with. These aspects were covered in an article in the *Electrical Review* of 19th March. The book is a valuable conspectus of and tribute to the work of the Society and the eminent people who have been associated with it. The illustrations are good and there is a comprehensive index.—J.H.C.

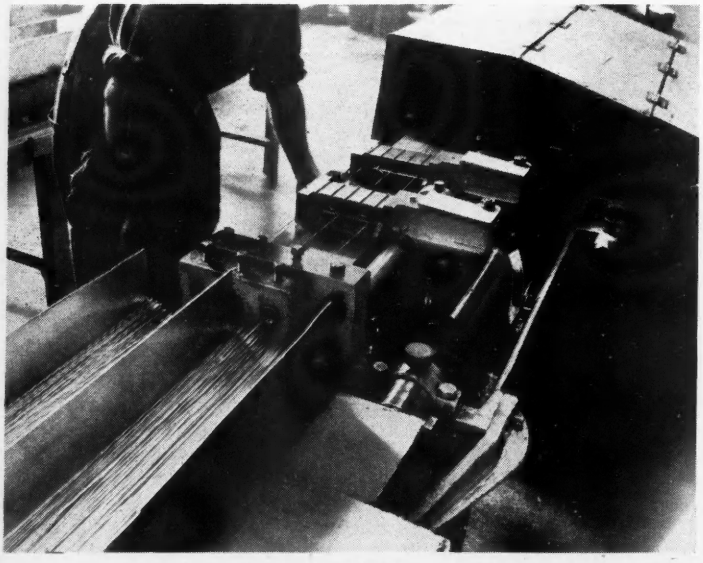
Aluminium Wires and Cables

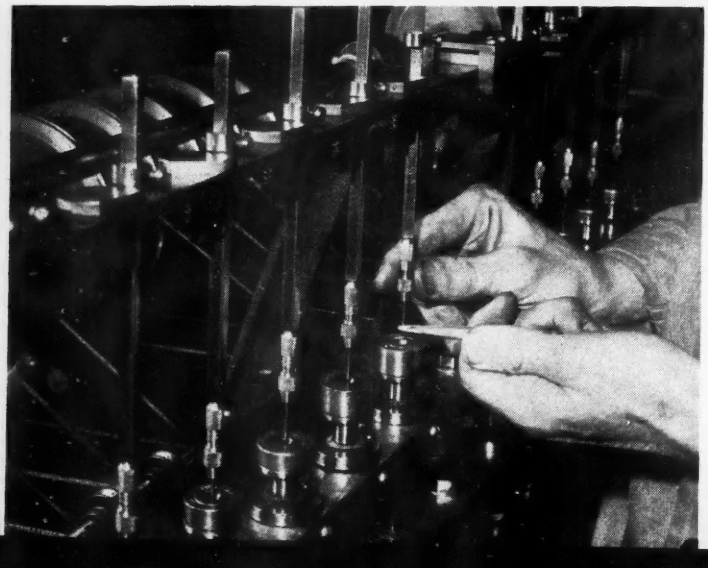
Modern Manufacturing Plant in South Wales

LAST week at the Port Tennant, Swansea, works of the Aluminium Wire & Cable Co., Ltd., we had the opportunity of inspecting one of the most up-to-date plants for manufacturing aluminium and aluminium alloy wire in various forms. We also had a look at the company's laboratories which are fully equipped to ensure the maintenance of a high standard of quality throughout every process from receipt of the raw materials at the works to dispatch of the final products to the customer.

The company was formed at the end of 1946 jointly by the British Aluminium Co., Ltd., Tube Investments, Ltd., and the Hawker Siddeley Group, Ltd., to meet the increased demand for all-aluminium conductors, steel-cored aluminium conductors and aluminium-alloy conductors (" Silmalec ") for overhead transmission and distribution of electricity, and for the production of aluminium rod and wire for general engineering purposes.

Wire straightening machine (top) and section of the die maintenance department showing die polishing in progress





The three participating companies, one of which (the British Aluminium Co., Ltd.) had been engaged in the manufacture of these products for nearly 50 years, transferred all their interests in aluminium wire and rod to the new company.

The works occupies an area of 10 acres and the rod-rolling mills, heat treatment furnaces, wire-drawing and stranding machines embody the latest developments in design and fabricating technique, thus ensuring a combination of high quality and low cost. The main shop of the factory houses a new semi-continuous mill for producing hot-rolled rod and is over 900ft long. A nearby site of some 60 acres has recently been acquired by the company for further extension of its manufacturing facilities.

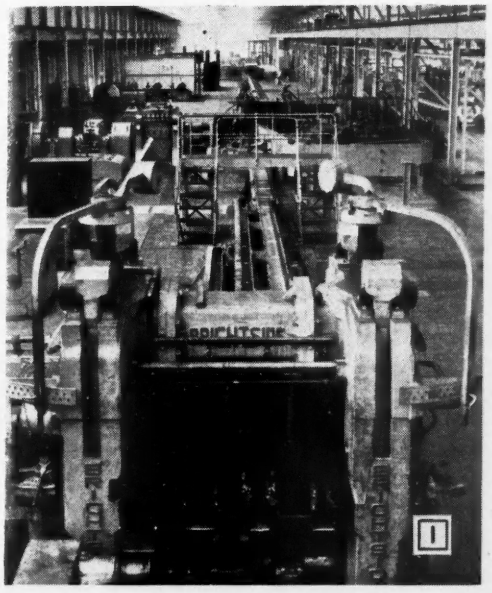
It is of the utmost importance that the rod which is used for the production of wire should be of consistent gauge and mechanical properties and have a surface free from defects. To ensure this quality while at the same time producing at maximum efficiency, the company in 1952 installed a high-speed semi-continuous rod mill of the most modern type specially designed for rolling aluminium and its alloys. It can be operated entirely automatically and consists of a two-high 21in roughing mill, a 16in intermediate mill and seven in-line finishing mills, the finished rod being fed on to two automatic coilers.

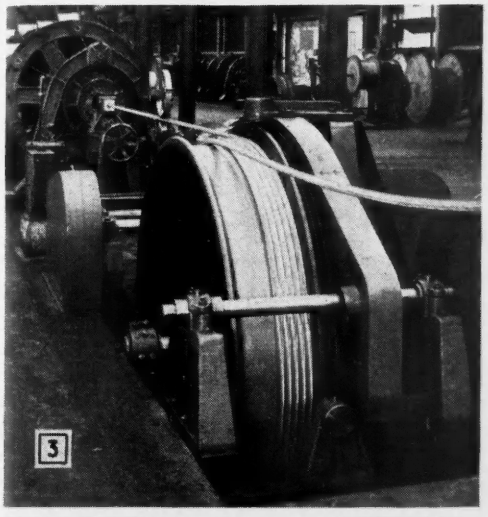
The mill is supplied with pre-heated wirebars 9ft long by 4in by 4in square section and weighing about 150 lb each from electric reheating furnaces. In the rolling process, the hot wirebar is progressively reduced in cross-section by passing it between a series of rotating grooved rolls until the required size of round rod is obtained; the rod is rolled to three standard sizes of $\frac{3}{8}$in, $\frac{7}{16}$in and $\frac{1}{2}$in diameter. The operating capacity of the mill is 6 tons/hr, or about 30,000 tons a year.

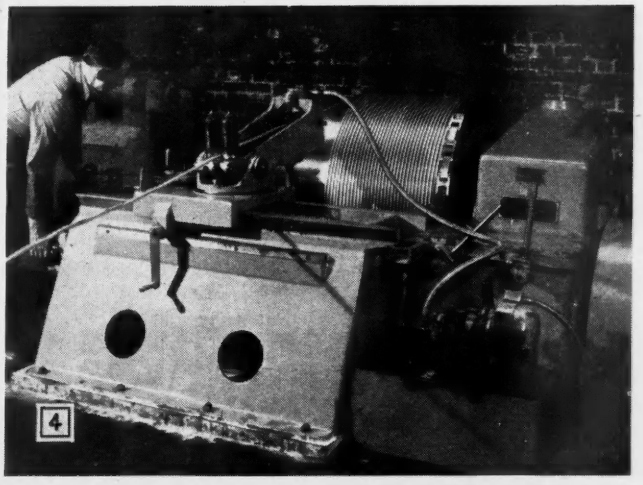
After the rod has been produced the next stage in the process is wire-drawing, and the plant employed for this purpose includes heavy duty, single die machines capable of drawing stock up to 1in diameter, 3, 5, 7, 9 and 11 die continuous machines used for drawing intermediate sizes and multi-die fine wire machines. Tungsten carbide dies are employed for drawing the larger and intermediate sizes of wire, while the finer wires are drawn through diamond dies. When the wire is to be stranded into conductors it is drawn direct on to the bobbins which are subsequently fitted into the stranding machines.

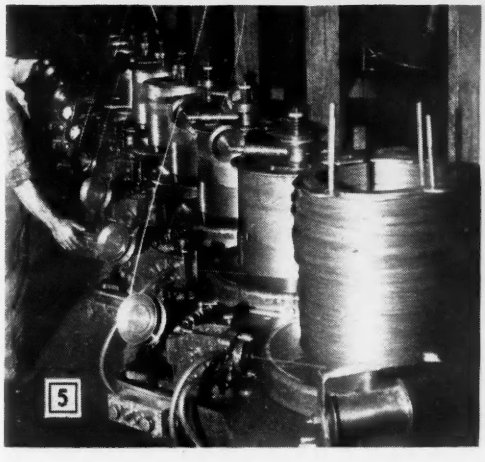
The multi-die continuous wiredrawing machines are of both slip and non-slip types. The operating speed varies within the range of 1,000–3,000 ft/min and the wire which is not required for stranding is taken up on standard blocks giving a finished coil. The fine wire machines are used for producing wire from 20 s.w.g. (0·036in diameter) down to 39 s.w.g. (0·0052in diameter). The operating speeds are up to 4,000 ft/min and wire down to 0·010in diameter can be supplied either in coils or on reels; below this size it is available on reels only.

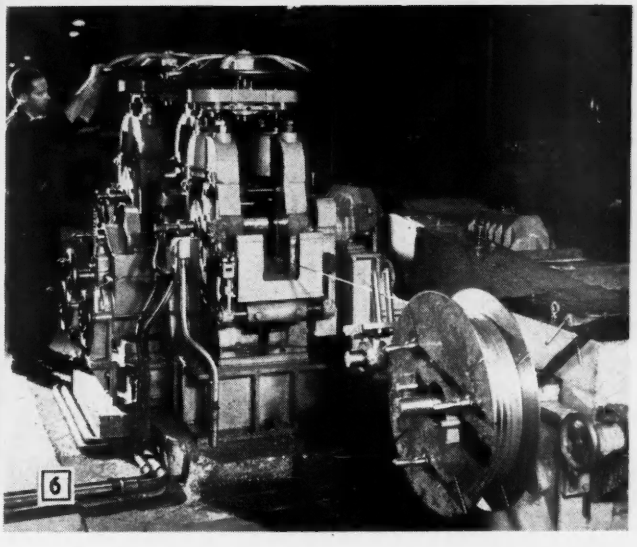
Annealing and heat treatment, essential processes in the production of many grades of aluminium and aluminium alloy wire, are carried out in electrical resistance forced-air circulation furnaces with automatic pyrometric control, and provision is also made for quenching. The furnaces are











1. General view of the semi-continuous hot rolling mill. 2. The finishing stands of the semi-continuous rod mill. 3. A 54 bobbin stranding machine producing 61/·125in s.c.a. conductor. 4. Heavy-duty single die machine for the production of drawn stock between ¼in and 1in diameter. 5. Eleven die continuous wire-drawing machine. 6. Tandem mill for producing flattened wire

situated adjacent to the wire-drawing machines to enable intermediate heat treatment to be carried out where necessary with the minimum movement of the material.

The final operation in the manufacture of stranded conductors is the stranding process itself in which the individual wires are built up to form concentric layers around a central wire, each layer containing a definite number of wires. The machines used for this work are of both the tubular and planetary type; the tubular machines produce 7-strand conductors and the largest planetary machine is capable of producing conductors having up to 169 wires.

The contamination of aluminium conductors by particles of copper is known to have an adverse effect upon their resistance to atmospheric corrosion. An important feature in the manufacture of stranded aluminium conductors at the company's works is their production under conditions in which, due to the complete absence of any copper production, no such contamination can possibly occur.

Many applications, such as machining stock, knitting needles, welding rods, etc., require wire to be supplied in straight lengths and the company is equipped to supply such material in any length up to 18ft. Narrow strip, produced by flattening round wire, is another form in which aluminium is supplied by the company. Strip produced in this way can be supplied in coils of greater length than those produced from slit sheet and is also free from sharp edges which are undesirable for many applications.

The company in addition manufactures aluminium alloy wire rope, a product which is now finding increasing application where there is a demand for a strong, light rope which will neither rust nor stain material with which it may be in contact.

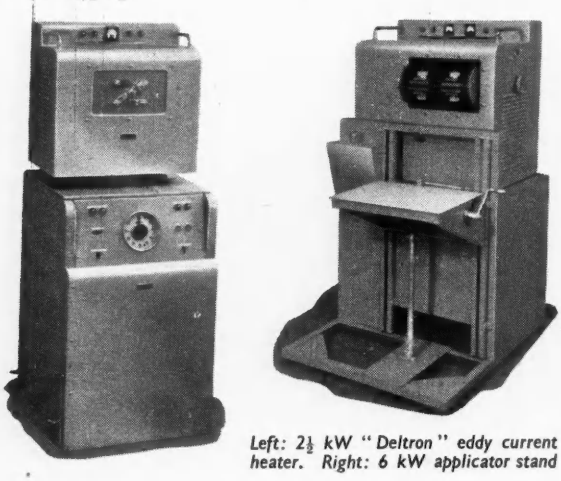
Various types of small mills are used for flattening wire up to $\frac{3}{4}$in wide in a range of thicknesses, and special equipment is available for rolling and layer-winding strip for special applications such as zip-fasteners, etc. A range of different types of straightening machines is also in use for the production of straightened wire and rod varying in diameter from 0·062in to 0·500in.

The production of high-quality wire, uniform in gauge and properties, cannot be achieved unless the dies through which the wire is drawn are consistently maintained to close limits. The company has installed all the necessary equipment to service both tungsten carbide dies used on the single and multi-die machines and the diamond dies used on the fine wire machines.

High-Frequency Heating

Standard Production Equipment for Unskilled Operators

ALTHOUGH high-frequency induction heating is being increasingly used as a means of reducing the time taken in soldering, brazing, annealing, tempering and hardening operations, the idea still seems to prevail in industry as a whole that the equipment employed is "temperamental" and requires operation by highly-trained experts. It is certainly true that the initial regulation of the apparatus for any particular duty may be critical and necessitate skill and care. Once this has been accomplished, however, equipment should continue to work for long periods without requiring attention and no more skill is required for production operation than, say, for press-work or welding. Workers previously engaged on soldering, annealing, etc., can actually be replaced by a much smaller number of unskilled workers and furthermore the finished job is superior and requires little or no subsequent "cleaning up."



Left: 2½ kW "Deltron" eddy current heater. Right: 6 kW applicator stand

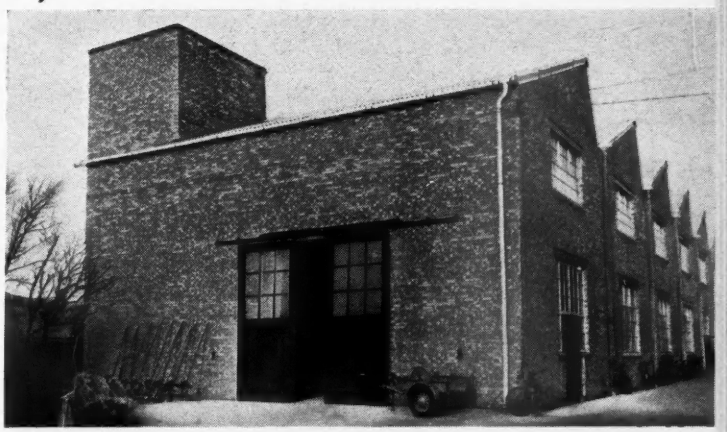
In designing their range of apparatus Delapena & Son, Ltd., Zona Works, Russell Place, Cheltenham, have kept this idea of simplicity of operation as the basic feature. There are no masses of dials to consult, control being literally by on/off switches. Standard models are now available giving outputs of 2½, 6, 10, 15 and 20 kW, while other units are also under development. Between them these should cover the majority of normal requirements. Apart from the question of simplicity of operation, special attention has been paid to safety. An earthing bar is provided on the 6,000 A anode circuit and there is an interlock on the circuit breaker. Water flow switches come into operation should the water supply for cooling the valves fail, while a thermostat switches off the electricity supply in the event of the fan failing. Radio interference suppressors are fitted and for guarantee purposes there is a meter for showing how many hours the valves have been used.

New uses of the apparatus are constantly being developed and the company has established an Application Section in which customers' special requirements can be studied in a practical way. If required special handling equipment can also be constructed. Another department is equipped to undertake sub-contract work for manufacturers whose heat treatment requirements are not sufficient to justify the installation of the necessary apparatus in their own works.

Apart from the advantages of eddy current heating already referred to, it is worth mentioning such other benefits as the possibility of adopting more economical manufacturing techniques, the virtual elimination of rejects, the reduction in inspection costs, saving in material, elimination of furnace stand-by losses, the ability to localize heat, and complete uniformity. In heat treatment problems the production times may be very substantially reduced and in many cases subsidiary operations can be eliminated. The savings made possible will of course vary considerably from one operation to another.

Control Gear Production

New Factory Opened at Brighton to Meet Increasing Demand



THE opening by Allen West & Co., Ltd., of a large new factory at Moulsecoomb, near Brighton, will permit a large-scale reorganization of production and office facilities necessitated by the growing demand for the company's manufactures.

Employing over 3,000 workpeople, and now claiming to be the largest makers of this type of equipment in the country, the company first started production in 1910 when it took over a section of the factory of the Reason Manufacturing Co., Ltd., specialists in d.c. electrolytic meters, demand indicators and time switches.

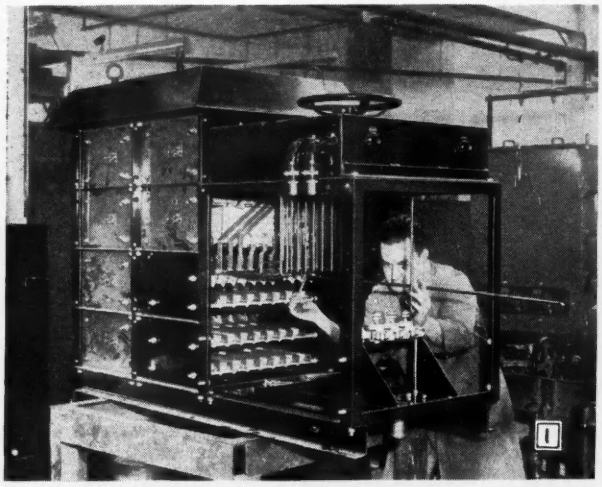
These original premises were extended over the years, until to-day they represent 194,000 sq ft of works and office area. The limits of the Lewes Road site having been reached in 1929, the company acquired an old armament works at Southampton. This arrangement, however, did not prove altogether satisfactory and in 1939 a new factory of 120,000 sq ft floor area was opened at Moulsecoomb, a mile or so from the main works, to replace the production capacity at Southampton.

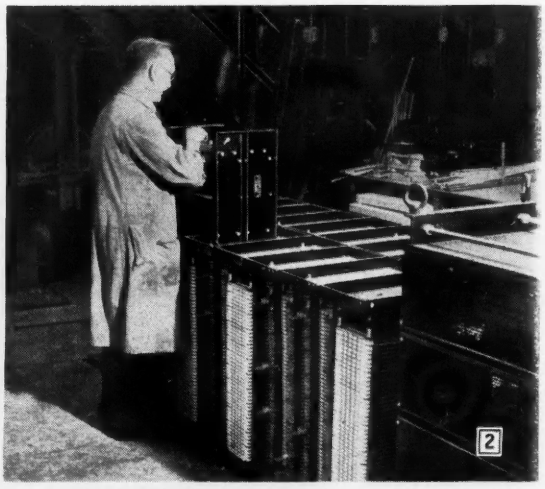
This Moulsecoomb No. 1 works was followed in 1941 by another block of 60,000 sq ft (No. 2) necessitated by wartime expansion. No. 3 factory, which opened recently and is now in full production, meets the demand for general expansion and is mainly utilized for assembly and testing, no machining work being undertaken here.

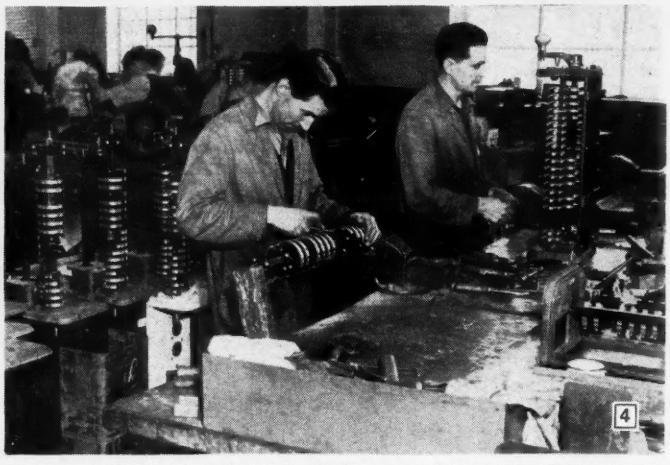
Adding a further 47,000 sq ft of production space, and completing over ten acres devoted to control gear production, the new factory is, due to site limitations, more or less triangular in shape and arranged mainly on one floor. The main products are oil immersed starting equipment and marine type control gear. At one end of the ground floor the heavier type gear is assembled. In the centre medium gear is dealt with, the remaining space being taken up by test sections, the dispatch department and, beneath the gallery, the stores.

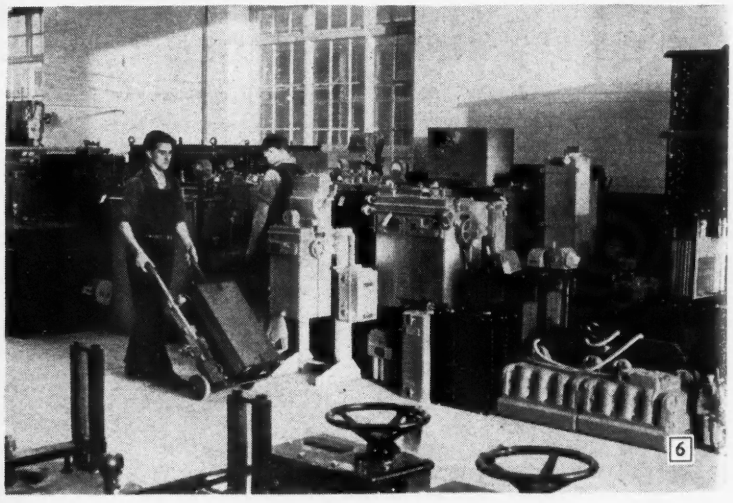
On the first floor, besides drum type controllers and resistances either for incorporation in other apparatus or for separate mounting, is produced the marine type gear typified by its particularly robust construction, heavy steel watertight enclosures for deck mounting, and solid cast brass cover hinges and fasteners. Marine gear is manufactured for both a.c. and d.c. applications associated with all shipboard auxiliaries. Among the apparatus on

Exterior of the No. 3 Moulsecoomb factory (above) and a general view of the new factory (below)









(1) Assembling the main connections of a rotor regulator for a 135 h.p. motor. (2) Assembling stamped steel grid resistances. (3) Testing oil break hand-operated starters. (4) Drum type controllers in course of construction. (5) Section of a large switchboard for a new Cunard liner. (6) This batch of apparatus awaiting dispatch includes liquid rotor starters, drum controllers, resistances, oil break hand-operated starters and marine type panels

view when we visited the works was one of a number of engine room panels forming a section of large switchboards to be installed in the new 22,000 ton Cunard passenger liners *Saxonia* and *Ivernia*. Other typical equipment awaiting dispatch included liquid rotor starters, oil break hand-operated starters and lifting magnets.

The building is equipped with a Stothert & Pitt five ton overhead travelling crane and a Waygood-Otis one ton lift. Cold cathode lighting utilizing "Ediswan" fittings is installed beneath the roof with hot cathode units (Crompton Parkinson) illuminating the ground floor. The premises are warmed by British Trane steam fan heater units.

Following the opening of this new factory it has been possible to make considerable alterations to the other works. This is particularly the case at the original Lewes Road works. Part of an assembly bay has been converted into a machine shop and the original machine shop has been laid out as offices of the most modern design.

DEVELOPMENT ON THE UP-GRADE

E.D.A. ANNUAL REPORT FOR 1953

MORE cheerful reading than for many years past characterizes the report for 1953 of the Council of the British Electrical Development Association presented at the annual meeting on Wednesday last. It says that resurgence characterized almost every branch of the Association's activities which, in turn, is clearly reflected in the consistently growing demand for electric services and appliances of all types.

Among the matters dealt with in the report is the work of the Joint Policy Council representing E.D.A., the British Electricity Authority, the Electricity Boards and the British Electrical and Allied Manufacturers' Association. Its purpose is to establish at the highest level the policy and objects to be pursued in the common quest of electrical development. An executive committee has been set up to endeavour to co-ordinate the separate activities of the bodies represented and a staff liaison panel has been formed to implement the decisions of the Joint Policy Council and the committee.

Three new contributors were enrolled during 1953—the Central Electricity Board, Malaya; the Punjab P.W.D., Electricity Branch; and the Electricity Authority of Cyprus.

Press Publicity

Reference is made to the more favourable attitude of the Press towards electricity as a result of which electrical matters have had considerable attention. During the past year the Association secured a wide measure of newspaper publicity. Satisfactory results were also obtained by the Association in its role of publicist for the British Electrical Power Convention at Torquay.

Representations on purchase tax on electrical appliances were made to the Chancellor of the Exchequer. Subsequently there was a general reduction of rates of tax and at the beginning of the year electric space heaters and immersion heaters were put on to the same footing as gas appliances. A booklet was prepared and circulated dealing with the electrical exhibits at the British Industries Fair at Castle Bromwich, and electrical equipment was provided for the exhibition houses in the Earls Court Section.

An advertising campaign to promote the use of cookers and water heaters was begun last May and the "Electricity for Productivity" advertisements were continued regularly throughout the year. Twenty-one new publications issued during 1953 included six agricultural and three industrial publications and three film catalogues. Fourteen forthcoming publications are listed in the report.

The production of four new films was authorized—Electricity and Smoke Abatement," "Electric Kitchen Planning," "Electric Cooking" and "Industrial Planning." The Film Library lent 14,880 copies of films, compared with 13,819 in 1952. Purchases of copies numbered 438 raising the total purchased to 2,408. Films went overseas and some were selected for exhibitions at home and abroad. To the photographic library 1,572 items were added covering many subjects. There were many loans of filmstrips and lantern slides.

Displays were planned and produced at 22 important national exhibitions; particular mention is made of those at the Schoolboys' Exhibition, the Ideal Home Exhibition, the British Industries Fair, the Building Exhibition and the British Electrical Power Convention.

Much was done to encourage rural electrification, including displays at a number of agricultural, horticultural and dairy shows, particularly the Royal Show, the Royal Highland and Welsh Shows, the English and Scottish Dairy Shows, the Smithfield Show and the Royal Horticultural Society's Show. The workshop unit at Lackham School was put into operation and it is to remain there for at least another year.

In the sphere of industrial electrification there was a great demand for the film "A Case for Handling." Many papers and lectures were given and there was a steady sale of the first four "Electricity and Productivity" handbooks; two others were prepared. Many factories were visited to secure material for a new film dealing with factory layout.

Electricity and Housing

A large number of inquiries were received from prospective house builders on the latest practice in installation and appliances. The Association participated in the production of a booklet on the heat insulation of houses and prepared a list of recommended appliances for the use of housing authorities. Advice was given to architects and advertisements useful to them were planned for the architectural Press.

The Domestic Installations and Appliances Committee was re-named the Electrical Appliances Committee and its scope was widened to include other applications, e.g., commercial catering. The Cooking Sub-Committee discussed a number of factors influencing the development of electric cooking including installation and maintenance costs; the Sub-Committee was gratified to note the introduction of a number of new lower-priced cookers. Sales and publicity methods, the stock position and delays in delivery were discussed with the manufacturers.

Matters given attention by the Water Heating and Laundry Equipment Sub-Committee included the need for improved drying methods in communal laundries, the use of detergents in washing machines and the design of

immersion heaters and self-contained water heaters, with a view to reducing production costs.

Among the subjects reviewed by the Refrigeration Sub-Committee was the possibility of larder cooling units which would also provide a reasonable amount of water heating. The draft of a new commercial catering handbook was approved by the E.D.A./B.E.A.M.A. Commercial Catering Committee, among other activities. While recognizing that the Government cannot give directions with regard to the type of transport to be used, the Trolley-bus and Tramways Committee deplores the lack of encouragement given to a form of transport that can assist the national economy. Evidence of the value of electricity in reducing air pollution was submitted to the Committee on Air Pollution under the chairmanship of Sir Hugh Beaver.

Referring to the work of the E.D.A./B.S.I. Advisory Committee on Electrical Appliances and Accessories the report says that the Committee was gratified to note that an increasing proportion of cases before it were submitted by manufacturers rather than as complaints from other sections of the industry or the public. The advantages of submitting apparatus in prototype form are stressed. Reference is made to the subject of multi-way sockets and the sale of socket-outlets not complying with I.E.E. Regulation 1312(C). The new Testing House at Leatherhead was opened by Sir Henry Self in October last. During the year 104 reports on new apparatus and investigations were issued, together with 22 addenda covering revised appliances and additional tests. Reports prepared for the A.C.E.A.A. rose from 33 in 1952 to 43 last year.

After references to other activities during the year the report concludes with the usual reviews of the work of the Electric Vehicle Association and the Electrical Association for Women.

E.D.A. Conference

Importance of Load Factor Improvement

THERE was a record attendance at last week's E.D.A. Conference in London, 740 registering compared with an average of 150 before the war. As Sir Henry Self, president of the Association, said at the opening session, the conference marked a return to progress and sanity. The Government had now allowed the electrical industry to go forward with advertising, subject to the improvement of industrial use, productivity and load factor. The new generating plant installed, though solving the peak load problem, inevitably emphasized the difficulty of securing high load factor. By encouraging the domestic consumer to use as many appliances as possible it would be possible to get a diversity of use which would improve the load factor. With regard to rural electrification he pointed out that it must be understood that it could not be remunerative for a number of years. Nevertheless it was now planned to give supplies to 85 per cent of all potential rural consumers within ten years in all but a few areas.

Dame Caroline Haslett, chairman of the E.D.A. Council, who presided, declared that never before had the public needed electricity as it did to-day, in the home, on the farm, in commerce and industry.

Mr. H. J. Randall, chairman of the London Electricity Board, said that commercial progress must keep pace with technical advances. They must see that increased charges did not result in reduced consumption.

A general discussion on Friday emphasized a number of points raised at the previous sessions and raised new topics. Presiding, Mr. V. W. Dale, director and secretary of E.D.A., spoke of the Association's industrial development work, referring to technical advertising and the series of productivity publications produced, including two new ones in course of preparation on industrial electric trucks and electric motors and controls. He mentioned suggestions that E.D.A. should run a training establishment for industrial specialists and also operate an advisory service. The question was raised whether the Association should next year give attention to a re-wiring campaign or continue with its domestic development campaign.

Mr. H. D. W. Allen (E.E.B.) thought engineering aspects were secondary to developing the commercial side of the business. Mr. W. P. Warren (S. Wales E.B.) on the contrary stressed the importance of an engineering background. The question of remuneration was raised by Mr. A. Watts (L.E.B.), who suggested the introduction of a special grade of pay for showroom staff.

The need to maintain the industry on a business basis was stressed by Mr. J. Hill (E.M.E.B.), who said that the future lay in all engineers developing methods for improving load factor and selling more electricity. Mr. H. Ainsworth (N.E.E.B.) spoke of the opportunities for electrical development even where gas was particularly cheap. Mr. F. A. Hitchcock (S. Western E.B.) thought special attention should be paid to making clear to the consumer what facilities were available to him, especially regarding the most favourable tariffs for particular purposes.

Mr. A. O. Johnson (N.W.E.B.) said they had to decide to what extent they could afford to develop each particular kind of load. The national needs might run contrary to the Boards' interests. He strongly favoured the development of the domestic load which would have as its ultimate end the improvement of the load factor. The nation demanded the development of the farm load but it was not a very good commercial proposition. Space and water heating and perhaps baking could be encouraged in commercial premises but he was worried about the industrial load and did not see how it could be made economic, except perhaps on the two-shift basis. Mr. L. L. Goodman (E.D.A.) thought it would not be possible to secure labour for a second shift. He wondered whether E.D.A. could not set up a national clearing house for special problems, with the issue of periodical broadsheets.

Speaking on the training of salesmen, Mr. J. A. Stedman (E.D.A.) thought that in view of the difficulties in numbers the matter should be dealt with on a local basis. He pointed out that schemes were already available for training supervisors. Miss K. Wilson (B.E.A.) also opposed the establishment of central training schools.

Mr. S. C. Dinenage (M.E.B.) advocated a central pool of information for unusual problems. Mr. F. C. Orchard (E.E.B.) said that no training was a substitute for experience. He was appalled at the over-motorization of factories and suggested the giving of advice to industrialists on the more efficient operation of their plants. Mr. D. Hart (S.W. Scotland E.B.) said that local councillors seemed to have the idea that people did not want electric cooking. He would like to know the percentage of electric cookers installed in new houses.

Mr. Dale said that the second edition of the E.D.A. list of approved appliances would be circulated shortly. The largest-ever press advertising campaign was in hand and new films were being prepared on electric cooking, kitchen planning and industrial applications. He suggested the giving of lectures on public speaking in the areas or sub-areas.

Collecting Rural Accounts

THE PROBLEM of collecting electricity accounts in rural areas is discussed in a report to the East Midlands Electricity Consultative Council by the Leicestershire Local Committee. In some villages rooms are rented by the Electricity Board on certain evenings to enable customers to pay locally, but it would not be economically possible to extend this facility to all villages. Therefore, it is suggested that dual purpose vans combining the functions of demonstrating appliances and collecting accounts should make regular visits to these outlying areas. This proposal is to be considered again by the Committee at its next meeting, when detailed information will be available.

Rural Progress in North West

With the inauguration of an electricity supply for the village of Blindcrake, Cumberland, the North Western Electricity Board has completed the first stage of its plan to supply electricity to rural districts in its area. The supply to Blindcrake involved the installation of 1½ miles of h.v. line and the building of a transformer station.

Scottish Distribution Scheme

Isolated parts of Nairn, Moray, Inverness and Banff will receive an electricity supply in the next four or five years. The scheme, which will cost some £300,000, was announced by Sir Hugh Mackenzie, deputy chairman of the North of Scotland Hydro-Electric Board when speaking at Inverness recently. The contract for the work has been placed with B. French & Co., Kidderminster. The cost of serving each consumer is estimated at £250, but apart from being asked to guarantee a minimum annual revenue of £3 per room or per 1,000 sq ft of steading, prospective consumers will be able to obtain their electricity at the same rate as in towns.

Ulster-Scotland Link Uneconomic

In the Northern Ireland House of Commons recently the Minister of Commerce (Lord Glentoran) said he was advised that the linking of the Northern Ireland electricity supply system with that of Scotland would not be an economic proposition.

Wiring Plans

Sittingbourne and Milton U.D.C. has agreed to the installation of electricity in pre-war Council houses not already served. The total cost is given as about £13,000, the work to be carried out in stages.

Stamford Town Council is considering a plan to modernize pre-war houses at a cost of £38,500, including £12,000 for the provision of electricity.

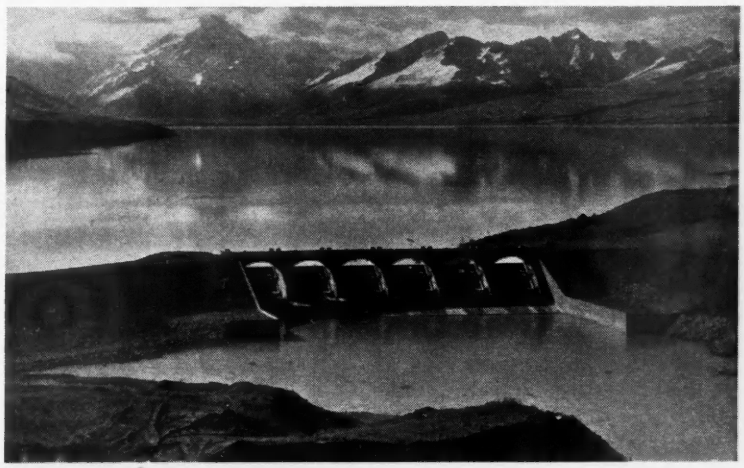
Burnley Education Committee is recommended to agree to a scheme for the rewiring of the Municipal College with the exception of that part comprising the recently completed extensions. The estimated cost of bringing the whole electrical system up to modern standards is £7,000.

Appliances in Council Houses

The North Eastern Electricity Board is to discuss with the Jarrow Town Council the installation of electrical appliances in Council houses. It is also to institute a system whereby electricity bills can be paid in fortnightly instalments.

Progress in the North East

At the quarterly meeting of the North Eastern Electricity Consultative Council at Newcastle-on-Tyne it was reported that during December, January and February 168 new substations had been put into operation. The great majority of these were concerned with supplies of electricity to villages and farms. In addition h.v. supplies were afforded to 25 industrial and commercial consumers. During the same period 161 miles of cables and mains were commissioned, 244 farms were connected and negotiations were completed for supplies to another 524 farms. Twenty-seven villages were given a supply of electricity. The North Eastern Electricity Board, it was reported, had approved

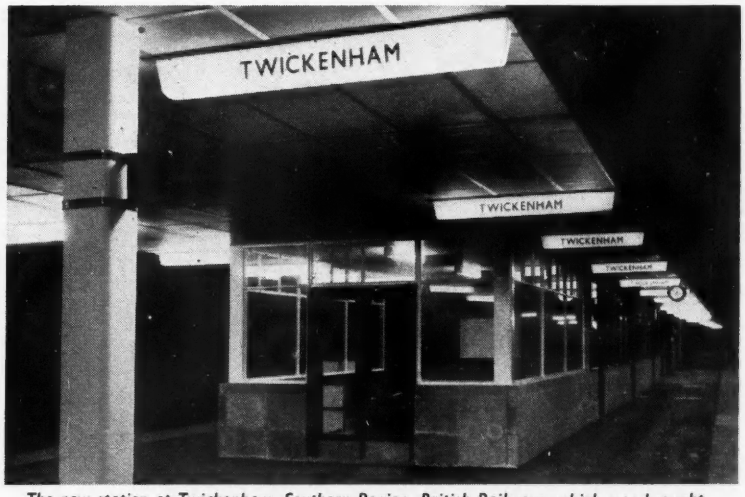


Progress of New Zealand hydro-electric schemes: two recent photographs showing the control works at Lake Pukaki in the head waters of the Waitaki River (above) and the Roxburgh dam on the Clutha River in course of construction

estimates amounting to £1,402,721 covering schemes including 78 for housing and 308 for rural supplies. It was announced that the Board was to open service centres at Hebburn and Jarrow.

Easy Payment Stamps

Since the North Western Electricity Board started experimenting in 1952 with its easy payment 2s 6d stamp scheme, a million stamps, representing £125,000, have been sold in the Board's Service Centres. These stamps are available at the Board's ninety-five service centres. They are bought by consumers at any time and fixed to special cards provided by the Board, the total on the card being taken into consideration when quarterly accounts are being paid.



The new station at Twickenham, Southern Region, British Railways, which was brought into use recently, has G.E.C. fluorescent lighting giving a high degree of illumination

TRANSPORT

Electric Railway Jubilee

This year marks the 50th anniversary of the starting of the electric train service between Newcastle-on-Tyne and the east coast. The service began on 29th March, 1904, when the first electric train left New Bridge Street station, Newcastle, for Benton. Some years later the electric line was extended to the Central Station, Newcastle. At present more than 200 trains run on the route each day and about 16 million passenger journeys are made each year.

Sodium Foglights

To improve traffic conditions during foggy weather "Mazda" sodium floodlights have recently been installed at the junction of Baker Street and Park Road, London. Six "23" floodlights housing 140 W sodium lamps are mounted at heights of between 6 and 8ft on poles set a little behind the illuminated "Keep Left" bollards. Advantage has been taken of the broad rectangular light distribution of the "23" floodlight by mounting a projector at both ends of some islands to illuminate both the junction proper and the approaches, one projector providing general illumination over the whole road width.

Front view of "Mazda 23" floodlight and control gear box specially pole mounted for floodlighting road junctions during fog

Hampstead Tube Lifts

As part of a programme for modernizing lift equipment at a number of London Transport stations, two high-speed lifts were brought into service on Monday last at Hampstead, London's deepest tube station. The new installation replaces equipment which has been in use since the Northern Line was opened in 1907.

At Hampstead, the travelling distance from booking hall to lower level is 181ft 4^{3}in, permitting a speed of 800ft/min, and as a result the journey time between landings is reduced from 53 to 21 seconds. To provide the additional over-run necessitated by the greater speed the floor of the machine room over the shafts had to be raised by 7ft 9in and the bottom of the shaft lowered by 2ft 6in.

The new lifts are arranged for control either automatically or by the staff. In the former case, the control equipment enables the lifts to be set to operate continuously without attention and also ensures that they leave at regular intervals, which can be varied to suit traffic demands. Signs show the position of each lift in the shaft and when switched to automatic control these are illuminated 6 sec beforehand to warn passengers when doors are about to close; this warning is supplemented by a loudspeaker.

Each lift is designed to carry thirty passengers but will take up to forty under heavy traffic conditions. Both will work in conjunction with two of the older lifts which are being reconditioned. The work, which was carried out by Waygood-Otis, Ltd., took twenty months to complete, and cost in the region of £70,000.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 24th April:—

DURAC. No. B608,254. Class 9. Electric accumulators and parts.—Accumulatoren Fabrik Akt.-Ges., Frankfurt-a-Main, Germany. Address for service, c/o Edward Evans & Co., 14–18, High Holborn, London, W.C.1.

CHROMAC. No. 724,247. Class 9. Electrodes for use in the electric welding of chromium alloys.—Rockweld, Ltd., Commerce Way, Croydon, Surrey.

SOLAS (design). No. 718,986. Class 9. Radio apparatus adapted for use in lifeboats.—International Marine Radio Co., Ltd., Intelco House, 21, Progress Way, Croydon, Surrey.

ELECTROMASTER. No. 719,874. Class 9. Radio sets (sold complete) and parts included in Class 9; radio gramophones and parts and television receivers and parts.—Philco Corporation, Philadelphia, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5–9, Quality Court, Chancery Lane, London, W.C.2.

TILTRAY. No. 724,750. Class 9. Electric relays and electric switches.—Besson & Robinson, Ltd., 6, Government Buildings, Kidbrooke Park Road, London, S.E.3.

CRAB (design). No. 724,996. Class 9. Electrical apparatus and parts and fittings.—J. A. Crabtree & Co., Ltd., Lincoln Works, Lincoln Road, Walsall, Staffs.

MICRONECTOR. No. 726,242. Class 9. Plugs, sockets and switches, all being electrical goods and parts included in Class 9.—The McMurdo Instrument Co., Ltd., 10, Upper Berkeley Street, London, W.1.

PLASTISEAL. No. 726,806. Class 9. Electrical condensers.—Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, W.3.

SPEEDWELL. No. 726,855. Class 9. Motor car batteries.—Speedwell Batteries (London), Ltd., 3A, Mardale Street, Goldhawk Road, London, W.12.

PANELESCENT. No. 722,967. Class 11. Electric lamps.—Sylvania Electric Products, Inc., Salem, Massachusetts, U.S.A. Address for service, c/o Stevens, Langner, Parry & Rollinson, 5–9, Quality Court, Chancery Lane, London, W.C.2.

COLOUR GLANCE. No. 725,518. Class 11. Installations and apparatus for cooking and heating purposes.—Simplex Electric Co., Ltd., Broadwell, Oldbury, nr. Birmingham.

MAGNALITE. No. 727,010. Class 11. Electric lamps for road vehicles.—James Neale & Sons, Ltd., 68, Graham Street, Birmingham, 1.

Magnetic Measurement

New Techniques Described at I.E.E. Section Meeting

RESULTS of an investigation into the static and dynamic elastic properties of resilient materials were given in a paper presented on 6th April before the Institution of Electrical Engineers (Measurements Section) by Messrs. R. S. Jackson, A. J. King and C. R. Maguire (Metropolitan-Vickers Electrical Co.). The common use of static data in choosing resilient mountings, the authors pointed out, might yield misleading results, since ratios between static and dynamic stiffness could be from 2 : 1 to 10 : 1.

The first aim of the investigation was to fill the gap in the behaviour of the two conditions which were believed to merge at some frequency. The development and performance of two machines (large and small) designed for the dynamic testing of twin samples of typical materials under compressive loads were described, the frequencies employed ranging from one cycle in ten minutes to the lower audio register. Agreement between results with the two machines was within 4 per cent. Frequencies at which wave motion occurred in rubber-like materials of dimensions common for resilient mountings were generally several thousand cycles per second. With high quality soft rubber the transmitted force might be seven times that at low frequencies for a given oscillatory deformation. Measurements made continuously for 1,000 hours at 21 deg C of both creep and incremental stiffness for natural cork, soft rubber and glass wool by simple beam arrangements showed that most creep occurred during the first hundred hours.

Torque Measurement

A new method of using microwaves for electrically measuring torque by a small displacement of a rotating shaft was described by Mr. N. C. de V. Enslin (University of Cape Town) in a paper at the same meeting. It was based on the sensitivity to small dimensional changes of cavity resonators used as frequency stabilizing units or wavemeters for the 10 and 3 cm bands. The cavity was enclosed by walls of high electrical conductivity which permitted the excitation of high-frequency alternating electro-magnetic fields. Resonance existed at fixed frequencies at sharply defined points which were a function of the dimensions of the cavity, the power fed into which at a fixed frequency was measured by a crystal detector at the outlet at different displacements. Where a 10-inch displacement was obtainable, the accuracy was within ±1 per cent. No sensitive indicating instruments or high-gain amplifiers or sliprings were required. It was stated that, apart from the measurement of torque, there were several applications of displacement measurement to which the microwave method could be applied with its maximum sensitivity.

Measuring Mechanical Hardness

A non-destructive method of ascertaining the hardness of ferromagnetic metals by a new technique was introduced in a paper by Mr. D. Hadfield (Swift, Levick & Sons). The direct relationship between magnetic permeability and mechanical hardness of a 1 per cent carbon 1·3 per cent chromium steel was used for developing a robust portable d.c. magnetic apparatus (consisting of three items) for measuring the mean volumetric hardness of two machined steel components of diverse character within a few seconds, which could be done by unskilled personnel in routine testing. Reproducibility was stated to be within 1 per cent. Correlation curves between the instrument reading (proportional to magnetic induction) and mechanical hardness were almost linear.

DISCUSSION

Opening the discussion, Professor F. Brailsford (University College, London) said he was impressed by the thoroughness and comprehensiveness of the experimental work presented in the paper on the elastic properties of resilient materials. The paper was a very practical contribution to the solution of noise and vibration problems. With regard to the paper on the use of microwaves for measuring small displacements, it was very significant that microwave technique had advanced so far that one could contemplate using a " klystron " in a resonant cavity and all the other attendant gear for the purpose of measuring the torque in a shaft. He did not agree, however, that all this equipment was no more complicated than a potentiometer used with a resistance strain-gauge. With regard to the paper on mechanical hardness, he pointed out that the mechanical hardness of a metal depended on the internal strains in the crystalline structure, and that these internal strains also affected the magnetic properties. Unfortunately, there was no simple direct relation between mechanical hardness and magnetic hardness which was of general applicability. Whilst most permanent magnet materials were mechanically and magnetically very hard, a number of alloys had a high magnetic hardness and were relatively soft mechanically. Again, the lattice distortion which produced mechanical hardness was only one of the factors which produced magnetic hardness. The chromium steel used by the author had a complicated metallurgical constitution which depended on the heat treatment. Quenching from a high temperature gave a relatively low saturation value and so magnetic permeability was affected by quenching temperature. This change in permeability was not necessarily connected with hardness, because it was due to the magnetic constitution of the constituents of the steel.

Mr. C. E. Webb (National Physical Laboratory) said that the N.P.L. had developed a parallel method of non-destructive testing of armour-piercing shot based on the correlation of mechanical hardness with electrical resistivity. Performance depended on a number of factors, but it was related to a considerable degree to the mean hardness across a section of the shoulder of the shot. By measuring the resistance of a slab or slice at the shoulder one could, if there was a satisfactory correlation, derive a fairly good indication of the probable performance. Some 70,000 shots of various calibres were tested and it was possible to ensure a high degree of uniformity.

Mr. J. E. Holton (Admiralty Engineering Laboratory) said that experience had shown that the static stiffness of a sample differed according to its pre-history. If one was intent on getting a really representative figure, it did not vary much from the incremental stiffness as quoted by Dr. King. The result was that the dynamic/static stiffness ratio for the low frequencies went down practically to one. Furthermore, the static stiffness frequently quoted bore no relation to the kind of static stiffness one could obtain for oneself. This was one of the major points of the paper. Dynamic figures could be obtained for resilient materials; the static figures were always in some doubt. The properties one wanted were dynamic, and since these properties could be obtained in a machine of the kind described, these were the figures to use and not the static ones.

Mr. A. R. Payne (Research Association of the Institution

of the Rubber Industry) said he too doubted whether there was such a thing as static value. He had replotted Dr. King's results, taking reciprocal stiffness against frequency, in a number of slides. With the exception of butyl, which was the " nigger in the wood pile," there was a dead straight line over the whole of the frequency range for all the materials (silicone, bonded rubber and natural cork). Any attempt to find unique static value according to the curves shown in the slides would not meet with any one result.

Mr. D. W. Robinson (National Physical Laboratory) said that at first sight the important feature of the paper on resilient materials seemed to be the wide frequency range covered by the measurements and the wide range of materials. He had come up against a similar problem from an unusual angle. Mechanical impedance measurements on a high polymer had shown that it had many of the features of rubbers and plastics. Measurements on high polymers and silicone rubbers had shown a straight-line relation between inverse stiffness and frequency over a wide range. From tests on a fairly wide range of materials equivalent networks had been deduced which, after ignoring the inertness of the materials, gave different frequencies up to the order of 6,000 c/s. This took one into the region of wave motion and of a contribution from the mass of the material. But if one ignored this the rest of the equivalent network was reduced to a number of parallel branches of resistance capacity in series. The electrical analogue was the typical Voigt form of mechanical behaviour for materials having retarded elasticity or time-dependent elasticity. By extrapolation to lower frequencies results were obtained which were consistent with published data.

Mr. D. A. Harding (National Physical Laboratory) said he had been interested in providing a portable torsion meter for use in ships. The choice of the different physical methods of transducing twist into the electrical signal probably varied between the different applications. An instrument could be calibrated in the laboratory but not on a ship, and one had to be certain that it would give a true reading on a ship one had never seen before. After describing the instrument in question, he asked whether use could not be made of an elastic unit to convert twist into axial movement. He pointed out that there was no friction and no possibility of backlash. Nor was there any question of a bouncing effect.

Dr. J. A. King (Metropolitan Vickers) asked whether Mr. Hadfield had ever tried to correlate remanence or coercive force and mechanical hardness. It was the experience of his colleagues and himself that there was a close relationship between remanence or coercive force or some function of the two, such as flux measurement of a given magnetic circuit, involving both factors and the mechanical hardness.

Dr. L. Hartshorn (National Physical Laboratory) said that if one considered the problem of torque from the point of view of the electrical man, the main problem was mechanical. If the mechanical man had done his job and produced a gadget by which the torque produced a linear displacement, the electrical man could bring his technique to measure that displacement. The question then was what technique he should use. His own reaction was that one would measure capacitance which would give a high degree of sensitivity. But the condenser then created might give some trouble like instability. One might therefore take inductance. The cavity resonator was a combination of capacitance and inductance and a stability could be achieved with it which could not be expected with a parallel plate condenser. Probably the technique one had the apparatus for and the technique one was used to would seem to be the simplest, but it would be interesting to know where the cavity resonator really came in. He had no case to make, but was merely posing the question.

The authors briefly replied.

Future Use of Fuels

DELIVERING his presidential address to the Institute of Fuel in London on 8th April, Dr. W. Idris Jones, director-general of research, National Coal Board, opened with a survey of the relative uses of fuel and energy in the United States and Great Britain. The U.S.A. used annually for fuel and power the equivalent of 8 tons of coal per person, compared with Britain's 4·5 tons, and the average for the world of 1·5 tons. With only one-fifteenth of the population of the world and one-twentieth of its land area, the U.S.A. consumed one-third of the total world production of fuel and energy. We had to make the best possible use of the coal we mined. If the need were great enough, ways and means would be found of getting and using vast tonnages of coal which were now considered to be unworkable and unacceptable.

The demand for oil would continue to increase, and since indigenous oil reserves and production were negligible in comparison with the total consumption, imported oil would continue to be Britain's source of supply.

The output of electricity in Britain had increased fourfold during the past 20 years and this trend was likely to continue in the decades ahead. We could look forward to great developments in power generation, with two large internal grids and interconnection with the French power system. Generators of up to 200 MW capacity would be quite common and more than three-quarters of the coal fed to power station boilers would be pulverized. The average efficiency of power generation in the United Kingdom in a few decades would be about 32 per cent. Hydro and tidal power, equivalent to that obtained from about 6 million tons of coal, wind power equivalent perhaps to 1 million tons of coal and nuclear power might make useful additional contributions to British generating capacity. Increase in power demand would absorb these non-coal sources of energy, and coal would remain just as important in A.D. 2,000 as it was to-day.

Dr. Jones foresaw great possibilities in the application for fuel purposes of energy derived from nuclear fission. It was now practicable to produce in the fission of the uranium isotope U235 more secondary fuel (plutonium) than was consumed from the primary fuel (U235), and this " breeder " reaction had greatly enhanced the prospects of economic development of nuclear energy. One of the many problems in nuclear power generation was to generate the heat at a sufficiently high temperature to give a reasonable efficiency of conversion to mechanical power. Though there were many technical and economic problems to be solved, it was possible that a reactor system might be set up that within 20 years would generate enough electricity to save 20 million tons of coal annually. Decades would probably pass, however, before a large proportion of this country's electricity could be generated by nuclear reactors. The possible construction by British and American firms of atomic energy plants for installation in the less technically advanced countries overseas that were devoid of fuel would be welcomed.

Dealing with the direct use of coal in industry the president said that since 1949 the number of Lancashire boilers fitted with mechanical stokers had been increased 1·4 times, thus saving about half a million tons of coal a year. There would be in the future close grouping of factories to facilitate centralized heat and steam supplies from high-pressure water-tube boilers, while back-pressure generation would be a common feature of future power plants, frequently providing sufficient electricity for the whole power demand.

Dr. Jones concluded his address with a reference to the " shocking inefficiency of much of our fuel-using equipment in the past," and made a plea for more training, adequate technical and scientific knowledge and further research and development work.

Engineering in Europe

Abstracts from Foreign Technical Journals

AT very high voltages d.c. circuit breaking is very difficult, partly due to the fact that even high-current d.c. arcs have low voltage gradients which excludes the drawing-out of the arc as a method for arc quenching. Combined ionic valve and capacitor types of switchgear which were suggested are not only bulky and expensive, but also unsuitable for long-distance transmission service, whereas the principle of successive insertion of damping resistances does not permit of achieving the required breaking speeds on account of the high inductances of the d.c. transmission circuits.

The author reports experiments with a circuit in which the arc is shunted by an oscillation circuit with a preliminarily charged capacitance, the discharge current of which is superimposed on the d.c. arc, so that " artificial " current-zeros are produced; it is then possible to quench the arc by the quenching methods usual in a.c. circuit breakers. The total breaking current has thus the character of a damped oscillation, is asymmetrical, and the rate of rise of the recovery voltage across the contacts of the main circuit breaker (an auxiliary breaker being used for shunting the arc by the oscillation circuit) is small. The most favourable range of frequencies for arc quenching is of the order of a few hundred c/s. Longitudinal air-blasting is the preferred quenching method for " modulated " d.c. arcs of high and very high voltages. Details of the various circuits used in the experiments and oscillograms of quenching processes are presented.—" Arc Quenching in Switchgear used in D.C. Transmission Circuits at Very High Voltages," G. A. Kukekov and P. G. Sorokin, *Elektrichestvo*, No. 10, pp. 20–24, 1953, in Russian.

H.V. System Testing

Despite the leading role played by Sweden in the development of e.h.v. transmission, that country has not adopted the practice of erecting h.v. testing stations, which practically all other countries have now embraced. The Swedish viewpoint is that conclusive knowledge of the stresses imposed on electrical installations can only be gained by making measurements in the system itself in actual service conditions and that no testing station, however well equipped, can simulate actual service conditions and, particularly, fault conditions, in their full severity. Accordingly, all the sections of the 380 kV transmission line were subjected to most exhaustive tests even before the official acceptance tests, at voltages up to 600 kV, the system protection and control installations being tested separately. The acceptance tests on generators and transformers were made in actual service.

It can be shown that surge testing is possible in any modern interconnected system in a way to produce all possible cases with minimum interruptions of the normal service, whereas short-circuit tests are not really required, because their effects may be estimated from switching tests with large reactive (capacitive or inductive) loads. Very important requirements are measurements of corona losses and observations of the stability of the transmission under various events in service and of interference with telecommunications. The author gives a detailed description of the " field test bus " of the Swedish Hydro-electric Power Administration and of a typical field test, with a short report of its results.—" Field Tests on H.V. Systems," U. Sandstrom, *I.V.A.*, Vol. 24, No. 6, pp. 249–256, 1953, in Swedish.

Capacitor Control

The most suitable and widely used type of l.v. capacitor control is a combination of VAr-meter type relay with a time relay and, correspondingly, the associated switchgear is of the contactor type. As capacitors also need protection, the contactor must be fitted with a protective relay which will be of the thermo-magnetic type. The capacitor banks are subject to three kinds of accidents, viz., puncture of the dielectric of a capacitor (which, however, can be guarded against by fusible links in the capacitor banks, in series with each capacitor element), short-circuit between connections, when the s.c. currents may become very high (against this the thermo-magnetic relay is a good protection) and, finally, abnormal temperature rises of the dielectric due to switching surges or to voltage harmonics.

The author gives an overall calculation of the thermal stresses and estimates the possible harmonic contents on which the relay settings have to be based. A more detailed analysis of the stresses to be withstood by capacitors and contactors controlling them in various modes of operation follows. The cases treated are: direct circuit making, closing with series, or damping, resistances and, lastly, inserting the capacitor bank successively, by branches. It is found that the contactor current rating should be at least 1·3 times the capacitor rating (assuming an overload capacity of 10–20 times the rated current). For sectional insertion of the capacitor banks two contactors of the same type are required which should be provided with current-limiting reactors. Some numerical examples are calculated. —" Contactors for the Connection and Protection of L.V. Capacitors," A. Blancpain, *Electricité*, Vol. 37, pp. 177–183, 1953, in French.

Testing Transformer Oil

The Dutch draft standard V1043 which stipulates conditions for testing electrical insulating oils was largely based on the latest work on the subject carried out under the ægis of C.I.G.R.E., I.C.E. and other international organizations, but modified for Dutch conditions with regard to oil qualities which, according to the author's very comprehensive commentary on this draft, are rather more favourable than for many other nations.

Nevertheless, no risks are taken and the most up-to-date testing methods are employed for obtaining the most reliable information about every single oil characteristic that matters, in particular oxidation and ageing properties, sludge formation, flash-point, viscosity at different temperatures, chemical reactions, solidification, moisture absorption, dielectric strength, resistivity, thermal conductivity, specific heat, self-restoration after discharge or puncture, liberation of combustible gases, interfacial tension at the

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

separation oil-water, acid and saponification values, discoloration, etc.

The execution of all these tests, and set-ups, apparatus sampling methods used, etc., are described in great detail and schedules of the necessary tests and for the evaluation of the results are presented in order to show clearly whether an oil is suitable as supplied (or as found after a term of service) or needs treatment before it can be used (and what treatment). The tests are also divided into service and laboratory tests.—" Testing of New and Used Transformer and Circuit Breaker Oils," G. Jelier, *Electro-Techniek*, Vol. 31, No. 25, pp. 466–473, 1953, in Dutch.

Hydrogen-Cooled Machines

The historical introduction of this comprehensive article explains why an old European invention (1915) has so far been used mainly in the U.S.A. (since 1937), the reason being that American turbo-alternators, owing to the 60 c/s frequency, have to run at speeds 20 per cent higher than European generators of similar types, which increases the windage losses by 70 per cent. This makes two-pole turbo-alternators for 40 MVA uneconomic, so that hydrogen cooling becomes a necessity.

However, in recent years the introduction of hydrogen-cooled high-power units has progressed rapidly on this side of the Atlantic, so that a detailed consideration of all the aspects of design and operation of these machines is actually required. Reduced windage losses and improved cooling are not the only direct advantages of the H-atmosphere, resulting in the " indirect " advantage of increased output and efficiency; there are, in addition, the possibility of further increases of output by increased pressure, extension of service-life of the insulation, reduced fire risks, near-suppression of surface discharges and reduction of noise. The increased explosion risk is taken care of by the design of the generator and by the predominantly automatic hydrogen control (referring to pressure concentration and thermal conductivity) and, according to the experience so far available, no explosion has actually occurred yet in any of these machines. The small probability of an explosion would, furthermore, be practically reduced to zero by a further, likely, increase of the pressure by which even higher outputs could be obtained.

The article describes hydrogen-cooled A.E.G. turbo-alternators with all their auxiliaries and equipment, particularly hydrogen control and lubricating installations, filling and topping-up methods and gives details of the calculations of the economy of hydrogen operation.—" Hydrogen Cooled Electrical Machines," F. Moldenhauer, *A.E.G. Mitt.*, Vol. 43, No. 11/12, pp. 336–354, 1953, in German.

Cooker Switch Contacts

The problem of the contacts on switches for electric cookers consists essentially in finding contact materials representing an acceptable compromise between the requirements of electrical and mechanical wear resistance, safety of operation and durability on one hand, and reasonable price on the other hand. The kinds of contacts used in such switches are either pressure or sliding contacts, the latter mostly used in the form of block contacts.

The suitability of various contact materials is established by mechanical and electro-thermal tests, the theory of these tests being presented by the author, who also gives the calculation of the leaf spring for a required maximum and minimum contact pressure, simplified by convenient graphs. Furthermore, graphed test results for copper-brass contact pairs (sliding contact) and for a pressure contact with silver-plated contact studs are presented. Comparison of the results shows that the pressure contact type has definite advantages which are also reflected by its spreading use.—" The Problem of the Contacts on Switches for Electric Kitchen Ranges," J. Kirchdorfer, *E.T.Z.(A.)*, Vol. 74, No. 24, pp. 707–710, 1953, in German.

Contact Materials

Contact resistances of specimen bars of the following materials were measured:—Hard electrolytic copper, hard electrolytic copper silvered, ductile brass, cast bronze and aluminium. The bars were then exposed to various atmospheres for a period lasting from March to September, the places chosen being: (*a*) the yard of a big chemical works with a corrosive atmosphere; (*b*) the yard of a big chemical works with a less corrosive atmosphere, but near a power station; (*c*) the yard of an iron works; (*d*) the yard of a cement works; (*e*) high up in the mountains, near a storage lake; and (*f*) the yard of a power station in a big town.

After the testing period, contact resistance, mechanical characteristics, surface condition and structural changes were examined. As expected, the rise of the contact resistance was smallest for silvered copper (provided the silver coating was sufficiently thick) and was roughly of the same order in dirty and clean atmospheres (about 30 times). For bare copper the rise is higher than for bronze in corrosive atmospheres. Certain chemical vapours cause brass to lose all its mechanical strength, though the surface of the brass is not affected by them. Aluminium shows only a slight rise of the contact resistance in corrosive atmospheres, but in a clean and wet ambience its surface becomes coated with an insulating oxide layer.—" The Influence of the Ambient Atmosphere on the Contact Materials of Electrical Apparatus," F. Houšt, *Elektrotechn. Obz.*, Vol. 42, No. 12, pp. 699–703, 1953, in Czech.

Rectifying Wattmeters

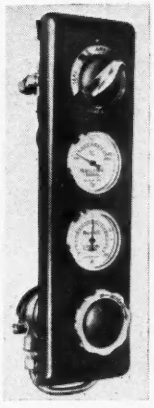
Rectifying wattmeters, i.e. combinations of electrodynamic wattmeters with some type of rectifier (as a rule, CuO), have the advantages of a higher sensitivity and small power loss, and are, therefore, suitable for measuring small powers down to 0·01 W and for work at frequencies up to 10 kc/s. They are also simple and cheap and can be built as integrating and multi-range instruments. Their main drawback is the inconstancy of the characteristic of the rectifiers which is the reason why these instruments cannot at present achieve a better accuracy than that corresponding to class 2·5. On the other hand, the rectifying wattmeters are practically independent of waveform, and of the corresponding measuring errors. The temperature errors of the instruments, appreciable in themselves, may be compensated satisfactorily. There is an interesting possibility of using these instruments as pick-ups for the instantaneous power values when power oscillograms are made.

The authors give the theory of the instrument and show how to overcome the difficulties of an accurate calculation owing to the non-linearity of the rectifier characteristic by the use of the method of equivalent e.m.f's. The calculation of the temperature compensation is also indicated. A multiple-range instrument designed on the method described for measurements between 0·01 and 100 W showed full coincidence with the calculated values on every scale division. Its systematical error was 3 per cent. The scale was uniform and the dependence on cos θ linear.—" Rectifying Wattmeters," K. B. Karandeev and A. Ya. Shramkov, *Elektrichestvo*, No. 12, pp. 44–47, 1953, in Russian.

NEW ELECTRICAL EQUIPMENT

Control Scheme Testing

THE introduction of composite automatic control schemes for continuous processes has accentuated the problem of servicing and testing the controllers without affecting the manual control of the plant. A new development of GEORGE KENT, LTD., Luton, Beds, is an auto/manual/test/service (A.M.T.S.) panel for use with its Mark 20 range of air-operated controllers, which allows uninterrupted manual control of the plant while controller servicing and testing is being carried out.



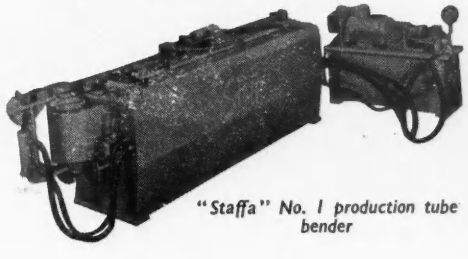
George Kent A.M.T.S. panel

The panel is used in cases where the regulating means is at some distance from the measuring instrument, making local manual control of the plant from the regulator position inconvenient. Often, also, it is an awkward and protracted business to change over to local manual control because of the regulator's position in the plant, and in such cases an A.M.T.S. panel is desirable.

Some plants can be damaged by such a sudden substantial movement of the regulator as may occur when changing from manual to automatic control, so a special balance gauge is fitted to the Kent A.M.T.S. panel. By means of this the manual and automatic control air pressures are equalized before the change is made from one control to the other, thus preventing sudden regulator movement. The panel incorporates a plug-type selector valve, regulating-signal gauge, balance gauge and manual-control wheel. The selector valve has four positions: auto, manual, test and service.

Tube Bender

It is announced by CHAMBERLAIN INDUSTRIES, LTD., Staffa Works, Leyton, London, E.10, that the company has developed, in conjunction with Walter P. Hill Inc. of the United States, a new high-speed hydraulic production tube bender. The machine, which is designed to handle tubes in sections, will be supplied in four capacities and the smallest model is suitable for bending 1in diameter 16 gauge copper tubing. The tubes are bent cold and the bending operation is automatic with each loading.



"Staffa" No. 1 production tube bender

Book Light

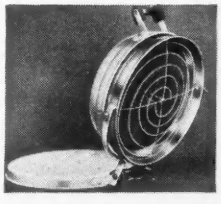
A small lighting fitting specially designed to clip on to a book has just been placed on the market by the MARTIN AGENCY, 43, London Road, Kingston-on-Thames, Surrey. A feature of the "Magic Booklite" is that when a book, with the fitting in position, is laid aside, or perhaps the user dozes off when reading in bed, the light is automatically switched off. A steel ball bearing in the body of the fitting makes, or breaks, a contact when in various positions, and to light the lamp it is only necessary to tilt it forward, then slowly return to a reading position.

The apparatus is moulded in two pieces and has a detachable shade, which facilitates the replacement of the 10 W, 220 V, s.e.s. bulb. At present it is available in only one colour, ivory white. The retail price complete with b.c. adaptor is £1 1s plus 3s 6d purchase tax in the United Kingdom.

Infra-red Unit

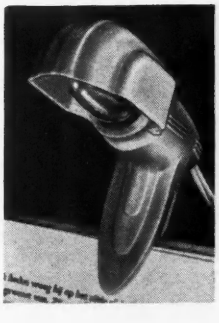
A new infra-red unit suitable for medical use is shortly to be marketed under the trade name "Deep Ray" by PERIHEL, LTD., Edge Street, London, W.8. Output is almost 1 kW and it is sufficient for full body treatment. It incorporates a safety element which is completely cemented and protected by a wire guard against accidental touch. Mounted on a solid base it is a compact little unit and when not in use it can be completely closed by means of the hinged cover and stored dust-free. By a touch of the handle it can be opened or closed and brought into the right operating position. No further adjustment is needed, except for a very simple wing nut adjustment for use over the bed.

The unit is priced at £5 5s and is exempt from purchase tax. A medical prescription is required when it is sold to non-professional users.



Above: "Deep Ray" infra-red unit

Below: "Magic Booklite" reading lamp



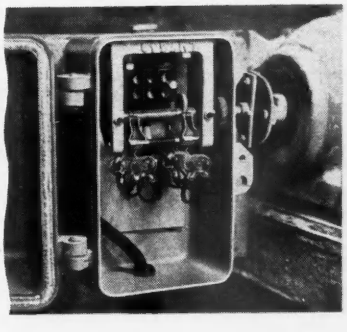
Weatherproof Rotation Switches

Patented weatherproof rotation switches are being made by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, for use with conveyors and other material handling equipment where a continuous process is concerned and warning of a breakdown or partial stoppage is essential. They are for attachment to the layshaft of a conveyor and are produced in two patterns, one to break circuit and the other to make circuit in the event of the shaft either stopping or rotating too slowly.

Each is fitted with two mercury switches of either delayed-break or delayed-make type, rated at 5 A 230 V a.c. or 1 A 230 V d.c. They are carried in cradles free to swing independently against light pressure, and are moved by two "Tufnol" cams diametrically opposed on a camshaft. It is necessary for the switches to remain stationary in either the break or make position (according to type) for 3 to 5 sec before they make or break the circuit. This may be brought about either by a conveyor stopping or going at a speed below that desired. The camshaft is made of stainless steel and projects through a felt packing gland in the side of the box so that it can be driven by a suitable coupling from any convenient shaft or take-off point of the machinery.

The switch cases are of aluminium alloy with a hinged lid which has

G.E.C. rotation switch directly coupled to the layshaft of a conveyor



means for padlocking. It is dustproof and weatherproof and is tapped with one $\frac{3}{4}$in e.t. hole at the top and one at the bottom (one fitted with a plug), to receive conduit or a cable gland. The external dimensions of the case are $8\frac{3}{4}$in high by 7in wide by $4\frac{5}{16}$in deep. Fixing centres are 7in by $5\frac{7}{8}$in for $\frac{5}{16}$in bolts.

A.C. Lighting Plant

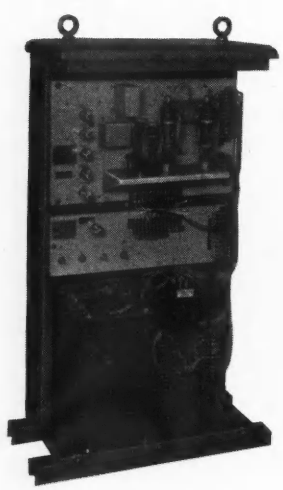
WORKMAN, REED & Co., LTD., Beacon Works, Hewish, Bristol, announce the recent introduction of a new range of small diesel lighting sets. These machines have outputs of 1 kW and $1\frac{1}{4}$ kW at 230 V single-phase a.c. and are available with five alternative methods of starting, including fully automatic, and mains failure control. They incorporate a Petter type single-cylinder air-cooled diesel engine and in addition to fitting a heavy flywheel for smooth running the makers have incorporated a vee belt drive to the generator.

The automatic models include the simple "Beacon" two relay circuit as fitted to the larger sets. The panel is arranged with an overload circuit breaker, starting battery, high and low charge switch, mains output ammeter and charge ammeter.

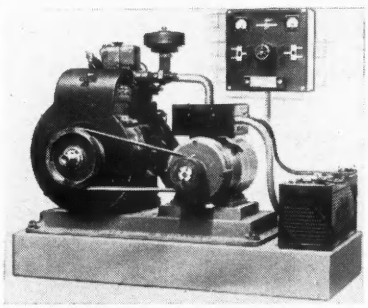
The sets are designed for small farms, country houses, yachts, etc., and the fuel consumption is claimed to be extremely low—a gallon in 14 hr. The overall dimensions are 2ft 4in wide by 2ft 11in long by 3ft high, and the approximate net weight is 450 lb.

"Unitized" Motor Control

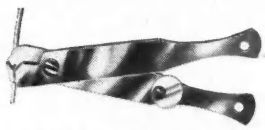
The system of "unitized" electronic motor control equipment, hitherto available only for units above 2 h.p., has now been extended by LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, LTD., Rugeley, to cover motors from $\frac{1}{2}$ h.p. up to .1 h.p. By this means it is possible to supply standard control cubicles equipped with one of a number of alternative chassis, adapting it to any desired type of drive. Skeleton equipment is also available.



Lancashire Dynamo "unitized" electronic motor control equipment



"Beacon type P" electric generating set



"Bib" wire stripper and cutter

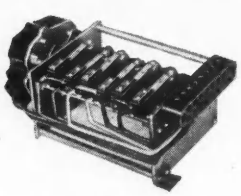
Wire Stripper and Cutter

An economically priced wire stripper and cutter has just been placed on the market by MULTICORE SOLDERS, LTD., Maylands Avenue, Hemel Hempstead, Herts. Shaped in the form of shears the tool is capable of stripping the insulation from most thicknesses of wire by means of the specially designed stripping jaws, and in addition it will cleanly cut the wire and split extruded flex. Adjustment for various thicknesses of wire or cable is carried out by a turn of a screw set in an eccentric disc.

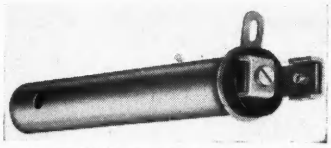
The "Bib" stripper has a nickel-plated finish and instructions for use are printed on the reverse side of its packing carton. The retail price is 3s 6d.

Process Timer

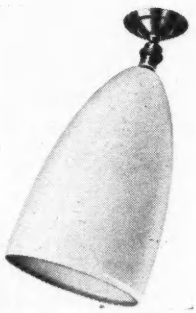
A new type of multi-circuit cam-operated synchronous process timer has just been placed on the market by the ELECTRICAL REMOTE CONTROL CO., LTD., Eastern Industrial Estate, Harlow New Town, Essex. It is suitable for controlling flashing neon signs, reversing of fans, staircase lighting control, etc., and by choice of a suitable synchronous motor and gearing the complete cycle of operations can take practically any time between one second and one week. Normal switching capacity of the contacts is 5 A at 230 V a.c. The timer is supplied either unmounted or mounted and provided with sheet metal covers having a black crackle finish. Weatherproof enclosures are available.



"Elremco" multi-circuit cam-operated synchronous process timer



Sunvic TQB water heater thermostat



Mazda "Cupola" spotlight fitting

Water Heater Thermostat

Recent developments in the application of immersion heaters have revealed a demand for simpler immersion-type thermostats which are set to a predetermined temperature and which can be withdrawn without draining the hot water system. These requirements are now met by SUNVIC CONTROLS, LTD., 10, Essex Street, London, W.C.2, with the introduction of a new water heater thermostat, type TQB, at a list price of only 15s 3d. It is a compact unit only 7in long overall and is designed to fit into a pocket with a nominal internal diameter of $\frac{3}{4}$in. The only external projections are the two connecting terminals, and the head of the immersion heater has been materially reduced in size. The thermostat is supplied at one of three settings, viz., 140 deg F, 160 deg F or 180 deg F and, while no calibration scale is incorporated, modification of temperature setting is possible by means of an adjusting screw.

Reflector Spotlight Fittings

"Mazda Cupola" fittings are now available from the BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2, for use with 75 W and 150 W reflector spotlight and floodlight lamps. They provide an inexpensive adjustable housing which may be mounted in any plane and trained through a cone with an angle of 38 deg from centre at right-angles to the mounting plane. The fittings have 2in centre mounting holes in the backplate and the respective overall lengths are $10\frac{1}{2}$in and 12in. They consist of spun aluminium housings, stove-enamelled dove grey and mounted on fully wired swivel brass lampholders, the prices being £1 7s 6d (75 W lamp) and £1 10s (150 W lamp).

IN THE COURTS

At Birmingham Assizes recently Mrs. Irene Moore (30) claimed damages against the British Thomson-Houston Co., Ltd., for an eye injury received during her employment at the company's Rugby factory. Mr. Justice Pilcher gave judgment for the defendants with costs, but assessed the damages, if the plaintiff had succeeded, at £300, and granted a stay of execution of 28 days for an appeal to be considered.

It was stated that Mrs. Moore was employed as a coil winder. On 25th February, 1952, she was operating a machine with very thin wire when the wire snapped and a piece ⅛in long lodged in her right eye. There was a slight, though permanent, impairment of vision.

Mr. S. Clarke, a director of the Connaught Engineering Co., manufacturers of the machine, said that during the past ten years his firm had supplied 290 machines and he knew of no firm other than the B.T.H. which fitted guards.

The Judge said it was by no means clear how the accident happened but he thought the theory of the wire hitting the top of the guard and a fragment breaking off was the most likely explanation. He considered that it would be quite wrong to hold that the defendants had been guilty of any departure from the standard of care required. There was a system in the factory whereby operatives could submit complaints to a welfare committee or to their own shop steward and it was quite clear that no complaint was ever made officially. The defendants were entitled to assume that the guard which they had provided after a previous mishap was an effective one. That they were "accident conscious" was shown by the fact that when the accident occurred the company installed a new type of guard.

Use of a Competitor's Catalogue

On 2nd April Mr. Justice Lloyd-Jacob gave judgment in the case of Purefoy Engineering Co., Ltd., v. Sykes Boxall & Co., Ltd., in which it was alleged that the defendants had infringed the plaintiffs' registered trade mark, had passed off their own goods as being the plaintiffs', and had infringed the plaintiffs' copyright in catalogue matter. His Lordship held that the claim for trade mark infringement was good, but that the plaintiffs had failed to establish either passing-off or infringement of copyright.

Mr. Purefoy had founded the plaintiff company in order to market his system of standard parts for making up jigs and fixtures, the parts being re-usable as needed. Mr. Purefoy did a large amount of spade work in introducing the system, although the idea of standard parts was not entirely novel, as similar parts were being made by another concern.

Between 1944 and 1948 Mr. Boxall (now of the defendant company) was employed by the plaintiffs as works foreman, and Mr. Sykes (now also of the company) was similarly employed and was responsible for the organization of sales. Some time after they had left that employment they went into partnership in direct competition with the plaintiffs, later forming the defendant company.

As regards the allegation of passing-off, the plaintiff company had instituted a system of code numbers by which the parts were known. The defendants, who offered some thirty parts, had a similar code, using letters and numerals. The evidence showed that several firms had adopted and used the plaintiffs' reference numbers when asking for quotations for standard jig and fixture parts from the defendants. There was no evidence that the use of these numbers was intended to do anything more than identify parts and their size; there was no question of asking for parts of the plaintiffs' manufacture. Requests were phrased, "Similar to Purefoy No. . . .," and the defendants' response did not disclose any intention to deceive. Where another's catalogue numbers are used in this way it is not right to infer a reference to the origin of the parts. Had a request stated, "We are given to understand that you manufacture Purefoy No. . . . parts," and had the defendants, in response, supplied parts of their own manufacture, there might have been a passing-off.

In respect of the copyright claim, a superficial examination of the plaintiffs' and defendants' catalogues disclosed a clear resemblance, and there were few differences. Both these points were relevant to the question of infringement. Where a competitor's catalogue is used as a pattern, or as a guide for making parts, the copyright is infringed. But if there is interest in a common subject-matter, as there was here, and the seller is not invoking the use of the other catalogue, there will be no infringement. It was submitted by the defence that these standard parts were well known in industry, and that they were copied as to style but not as to dimensions, which were arrived at by recollection and not from the catalogue. Although a study of both catalogues raised a *prima facie* presumption of infringement, there was no inherent improbability in the defence put forward. The defendants had only used the plaintiffs' catalogue as a model.

Tendering Procedure

Last year, with the support of the Minister of Works, the Royal Institute of British Architects, the Royal Institute of Chartered Surveyors and the National Federation of Building Trades Employers set up a Joint Committee on Tendering Procedure under the chairmanship of Mr. Howard Robertson, president R.I.B.A. In its report issued recently the Joint Committee expresses its general agreement with the 1944 Simon Report on the Placing and Management of Building Contracts and considers it regrettable that so little has yet been done to implement this report.

The most important recommendation of the Simon Committee was that relating to selective tendering and the Joint Committee endorses the view that in competitive tendering competition should be limited in each case to firms which have been carefully selected according to the type and size of contract. Indiscriminate tendering leads to bad work and unnecessary expenditure of time, effort and expense; only by selective tendering can a building owner expect a good standard of work at a fair price.

Selective tendering is normal practice with private owners and Government Departments. The two main methods are (*a*) to advertise each contract and ask firms to apply for permission to tender, when a suitable selection is made from applicants; and (*b*) to maintain lists of firms in different areas suitable and competent to carry out works of varying extent and character. In principle (*a*) is preferable although placers of a large number of contracts (such as Government Departments) find it unsuitable.

The majority of local authorities allow every contractor who wishes to tender for work to do so, believing that this avoids charges of partiality and leads to economical building. The Joint Committee regrets that the Ministry of Housing and Local Government has not encouraged local authorities to change their practice.

The report considers such matters as the cost of tendering, types of contract and related matters. One section deals with sub-contracts. While it is recognized that architects may wish to continue to nominate sub-contractors it is thought undesirable for clients to make direct contracts with specialists. Full support is given to the Simon Committee's view that the general contractor should, subject to the directions of the architect, be in full control of the executive work on the site. The Joint Committee says that there are many sub-contracts for which the main contractor might be given the opportunity of tendering.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 26th May from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1948

17315. Eckert-Mauchly Computer Corporation.—Electronic numerical integrator and computer. 28th June, 1948. (709407.)

1949

5867. Electric & Musical Industries, Ltd.—Talking machines. 20th February, 1950. (709472.)

15021. Johnson & Johnson (Great Britain), Ltd.—Treatment of dielectric materials to prevent or reduce development of electrostatic charges. 3rd June, 1949. (709555.)

1951

459. Power Jets (Research & Development), Ltd.—Electrostatic precipitators. 31st December, 1951. (709476.)

1077. British Thomson-Houston Co., Ltd.—Optical projection of images. 10th January, 1952. (709562.)

7351. Submarine Cables, Ltd.—Stranded electrical conductors. 21st March, 1952. (709394.)

7873. Aluminium Bronze Co., Ltd., and Cleiff, J. A.—Safety device of and for power-driven wringers. 5th November, 1951. (709428.) 7874. Driving mechanism of and for power-driven domestic wringers. 5th November, 1951. (709429.)

8989. General Electric Co., Ltd.—Methods of electric induction heating. 16th April, 1952. (709479.)

9930. Holophane, Ltd., and Holmes, J. G.—Light controlling glassware. 21st March, 1952. (709481.)

10292. Hoover, Ltd. (Dreyfuss, H.).—Washing machines. 25th April, 1952. (709433.)

13609. British Electrical Repairs, Ltd.—Automatic lifting dogs. 16th May, 1952. (709438.)

16050. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 3rd July, 1952. (709399.)

21121. Electric & Musical Industries, Ltd.—Smoothing irons. 8th September, 1952. (709448.)

23728. Metropolitan-Vickers Electrical Co., Ltd.—X-ray apparatus involving a charged particle linear accelerator. 25th August, 1952. (709451.)

25332. Clevite Corporation.—Magneto-strictive and electromechanical transducer device. 30th October, 1951. (709528.)

30214. British Thomson-Houston Co., Ltd.—Injection into charged particle accelerators. 27th December, 1951. (709491.)

30350. Siemens Bros. & Co., Ltd.—Counting relay chains. 12th December, 1952. (709456.)

1952

480. General Electric Co., Ltd., and Davidson, T. R. N.—Apparatus for severing lengths of glass rod or tubing. 7th January, 1953. (709402.)

1506. British Thomson-Houston Co., Ltd.—Ultra-high-frequency heating apparatus. 18th January, 1952. (709492.)

3834. British Thomson-Houston Co., Ltd.—Sliprings for dynamo-electric machines. 13th February, 1952. (709536.)

6969. British Thomson-Houston Co., Ltd.—Colour television systems. 18th March, 1952. (709496.)

7218. Burndept, Ltd.—Voltaic cells. 20th March, 1953. (709461.)

13314. Sunbeam Corporation.—Electric heating device with adjustable heating period. 26th May, 1952. (709602.)

16331. English Electric Valve Co., Ltd.—Methods of making very thin films. 6th February, 1953. (709503.)

18531. Eckert-Mauchly Computer Corporation.—Cycling device for electronic computing apparatus. 28th June, 1948. (709408.) 18591. Electronic multiplying apparatus. 28th June, 1948. (709409.) 18612. Register or accumulator for electronic computing apparatus. 28th June, 1948. (709410.)

19402. General Electric Co.—Magnetic recording and reproducing systems. 31st July, 1952. (709505.)

19810. Hazeltine Corporation.—Television field identification system. 6th August, 1952. (709468.)

22638. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 22nd June, 1953. (709615.)

25606. Hannon, T. W.—Electrically heated screen construction. 13th October, 1952. (709548.)

26096. General Electric Co.—Pressure reduction devices. 17th October, 1952. (709617.)

26934. Hazeltine Corporation.—Television field identification system. 27th October, 1952. Addition to 709468. (709508.)

28061. Standard Telephones & Cables, Ltd.—Band-pass electric filters. 7th November, 1952. (709509.)

30430. Hazeltine Corporation.—Colour-television signal translating system. 1st December, 1952. (709511.)

1953

19710. Automatic Telephone & Electric Co., Ltd.—Telephone systems. 3rd July, 1952. (709406.)

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Tuesday, 20th April

EDINBURGH.—Carlton Hotel, North Bridge 7 p.m. I.E.E. South-East Scotland Sub-Centre. Annual general meeting.

LIVERPOOL.—Merseyside and North Wales Electricity Board, Whitechapel, 6 p.m. I.E.S. Liverpool Centre. "Sports Lighting," by M. W. Peirce.

Tuesday, 20th April, to Saturday, 24th April

LONDON.—Holborn Restaurant. The Fourth International Conference on Electro-deposition and Metal Finishing.

Wednesday, 21st April

BRISTOL.—Grand Hotel, 7.15 p.m. Incorporated Plant Engineers, Western Branch. "The Gas Turbine Locomotive."

GLASGOW.—425/427, Sauchiehall Street, 7 p.m. Incorporated Plant Engineers, Glasgow Branch. "Hospital Heating: Modern Methods," by W. Russell.

LONDON.—School of Hygiene and Tropical Medicine, Keppel Street, W.C.1, 6.30 p.m. British Institution of Radio Engineers, London Section. "Crystal Valves in Radio and Electronics," by B. R. A. Bettridge.

PRESTON.—19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. Annual general meeting.

ROCHESTER.—Bull Hotel, 7 p.m. Incorporated Plant Engineers, Kent Branch. "Self-oiling Bearings."

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. Annual general meeting. "A Logical Approach to the Problems of Electric Space-Warming," by D. H. Parry.

Thursday, 22nd April

BIRMINGHAM.—Edgbaston Golf Club. Birmingham Electric Club. Golf Competition.

DONCASTER.—Danum Hotel, 7 p.m. Institution of Works Managers, Doncaster Branch. Annual general meeting.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Utilization Section. "Safety in the Use of Portable and Transportable Electrical Equipment in Industry," by J. Bunting.

164, Shaftesbury Avenue, W.C.2, 7 p.m. Television Society. "Valves for U.H.F. and V.H.F. Television," by D. N. Corfield. (Joint meeting with the Institution of Electronics, London Branch.)

NOTTINGHAM.—Gas Showrooms, 6.15 p.m. Institute of Fuel, East Midland Section. "The Future of our Power Supplies," by Prof. F. E. Simon.

WOLVERHAMPTON.—Star and Garter Royal Hotel, 7 p.m. Institution of Works Managers, Wolverhampton Branch. Annual general meeting. Speaker: Sir Charles J. Bartlett.

Friday, 23rd April

BATH.—S.W.E.B., Old Bridge Street, 7 p.m. I.E.S. Bath and Bristol Centre. Annual general meeting and film show.

BIRMINGHAM.—College of Technology, Room C.11, 6.30 p.m. I.E.E. South Midland Education Discussion Circle. "Elementary Electrical Laboratory Work," by J. E. F. Voss.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Education Discussion Circle. Discussion on "A Method for the Plotting of Magnetic Fields due to Currents," opened by Dr. F. T. Chapman and D. G. Sandeman.

Townsend House, Greycoat Place, 7 p.m. Junior Institution of Engineers. "Engineering Maintenance in a Paper Mill," by N. A. Holmes.

Easter School

Following the success of summer schools for professors and lecturers in engineering at the Metrovick Trafford Park works it is proposed to hold an Easter school from 21st to 23rd April for headmasters and senior science masters in order to give them a better appreciation of the opportunities offered to their pupils by the engineering industry.

Financial Section

STOCKS and SHARES

ELECTRICAL equipment shares have reacted positively to the implications of the Chancellor's tax allowances on capital investment expenditure. Otherwise, impressions made by the Budget on Stock Exchange markets faded out very quickly. Regrets at the absence of any reduction in direct taxation produced no more than an hour or two of slight depression on the morning after, and business returned rather quietly to normal at a level of prices higher than before. Indices to industrial share prices have, indeed, again broken the all-time record. On balance, gilt-edged securities show noticeable strength. In the industrial market, good features have been by no means confined to the sections concerned with the Chancellor's only important concession.

Electrical Equipment Shares

As noted above, the new allowances in respect of expenditure on plant and machinery were worked out to be in favour of heavy electrical engineering investments. It was argued in the market that the industry stands to benefit on two sides: firstly, through increased orders from industry, and secondly, because many of the electrical manufacturers themselves have large-scale capital projects on hand. English Electric, for instance, showed in its last accounts outstanding commitments of nearly £3½ million for capital expenditure. Under the same heading, A.E.I. declared a figure of over £2·8 million. Shares of these two companies led the advance in prices, English Electrics moving up from 40s 6d to 43s 6d, and A.E.I. from 46s to 47s 9d. Reyrolles advanced strongly to 76s 9d. These three are calculated to be among the principal beneficiaries following the demise of the excess profits levy.

Vickers

A rise in the price of Vickers £1 ordinary to 59s 3d was amongst the principal market reactions to the Budget. It was based, of course, on the view that the new investment allowances are of special interest to a group engaged, as Vickers are, in almost every important branch of capital equipment production. Apart from this, interest in the shares has been astir for some time in anticipation of the final dividend for 1953, due to be declared any day now. Vickers have yet to announce their decision on the question of repurchasing the nationalized steel interests: conversations with the authorities have been in progress for some months. Last year's balance sheet showed the company still to hold the original compensation in the form of British Iron and Steel Stock to the nominal amount of £12½ million. Clearly the future of the shares depends a good deal on the use to which the board decides to put that fund.

Ericsson Bonus Shares

Ercisson Telephones 5s ordinary are now quoted ex the bonus shares, which have been distributed to shareholders on a one-for-one share basis, and have been changing hands at around 24s 3d. They are at present transferable free of stamp duty. On the former ordinary capital the company raised the rate of dividend for 1953 from 22 to 25 per cent (including 5 per cent as bonus) tax-free. Assuming half that rate on the capital of just over a million ranking for this year's dividends, the prospective yield on the new shares is equivalent to about 4¾ per cent gross. This comparatively modest return evidently reflects the unusually strong financial position. From the dividend point of view, the latest distribution took only £125,000 net from an available surplus of some £425,000. As regards reserves, the total will still apparently be well over double the amount of ordinary capital, even after the bonus. In addition, the latest balance sheet shows net liquid assets of £3½ million.

Cable Company Dividends

British Insulated Callender's Cables' total distribution of 10 per cent for 1953 is at the same rate as last year's distribution, but is declared this time as all dividend, whereas 2½ per cent of the previous total was described as bonus. In addition a special tax-free payment of 2½ per cent is being made from realized profits. Trading profits are below the record level reached in the exceptionally favourable conditions of 1952, but with the tax provisions £2 million smaller on this occasion the group net surplus has increased to nearly £4 million. With the price of the £1 shares hardened after the news to 44s, cum-dividend, the yield works out at 4¾ per cent on a distribution covered nearly six times by available earnings. Telegraph Construction £1 shares were also unaltered, at 32s 6d, immediately after the final declaration, which brings the total to 8½ per cent and the return on the shares to 5·3 per cent.

Radio Activity

Continued activity in the group of radio shares has lately produced a number of good features. Outstanding was a jump in British Wireless Relay "A" shares from 17s to 21s. Recent comment on the company's prospects included a report that the use of some of London's disused tramway ducts has been acquired for the company's transmission lines. "Ekcos" put on 3s to 27s 3d and Ever Ready gained 4s to 32s 3d. Plesseys made further progress to 53s 3d. These shares could have been bought for about 20s at one time last year, and have come up from 38s since January. With the last annual report the company implied the intention of making a capital bonus distribution during the course of this year. Radio Rentals soared to 57s 6d.

Watford Electric Results

Watford Electric's final distributions of 10 per cent dividend and 7½ per cent bonus were well received in the market, the 2s shares being dealt in subsequently up to 6s 4½d. These payments apply to capital increased by 60 per cent, to £140,000, as a result of the share bonus given last August. Last year's total distribution of 25 per cent would have been equivalent to about 16 per cent on the present capital. Making the same adjustment to the 5 per cent interim paid for 1953, the latest total represents nearly 21 per cent, so that, in effect, shareholders are receiving about 5 per cent more this time. Trading profit for the year is reported at slightly under the previous figure, but after tax the net surplus is some £12,000 to the good at £36,400. The yield on the shares can be calculated to be about 6½ per cent.

Miscellaneous Matters

Thos. Tilling disappointed the more optimistic expectations in merely maintaining the dividend at last year's rate of 7½ per cent, which resulted in a fall of 2s in the price of the £1 shares to 34s. Group profits have expanded well, but larger deductions for taxation and minority interests leave little change in the net distributable surplus at £380,000. The 5s shares of Brush Electric, in which Tillings are now interested, have been moving erratically but in a generally upward direction; they came back to 6s 6d after changing hands up to 7s., the best price for two or three years past. A line of the 1s ordinary shares of Parmiter, Hope & Sugden, who announce the maintenance of the interim dividend at 7½ per cent, has been on offer at 2s 1½d to yield 12 per cent on last year's total distribution of 25½ per cent.

Owing to the Easter arrangements our usual investments table is omitted this week.

NEW COMPANIES

J. L. Shaw Electronics, Ltd.—Registered 31st March. Capital £10,000. Manufacturers of and dealers in electrical plant, machinery, etc. Directors: J. L. Shaw and Constance A. Shaw. Regd. office: 31, Market Street, Bradford.

Angelus (Harlow), Ltd.—Registered 26th March. Capital £1,000. Manufacturers and distributors of and dealers in electrical goods, radio and television sets, etc. Directors: C. A. Angelus, Mrs. Agnes H. Angelus and I. Younger. Regd. office: 70, Great Portland Street, W.1.

Chad Electrical Co., Ltd.—Registered 20th March. Capital £500. Directors: C. W. Hisgrove and Margery Hisgrove. Regd. office: 195, Old Oak Road, Acton.

REPORTS and DIVIDENDS

A. Reyrolle & Co., Ltd.—The 1953 accounts and dividends were referred to in our last issue. The statement to be made by the chairman, Sir Claude Gibb, at the annual meeting on 6th May, which accompanies the report refers to changes in the directorate and goes on to refer to the adverse effects of excessive taxation. This, the chairman says, more than any other factor, is making British industry uncompetitive in world markets. The additional permanent capital raised during the year is less than the amount required for taxation and the capital expenditure upon facilities for research and production. There is much non-productive Government expenditure which, through taxation, causes continued inflation and higher costs of living and selling prices.

Competition has recently intensified and to meet it the company's prices have been lowered and still greater efforts made to improve design and manufacture and thus reduce selling prices. But there is a limit to which this can be done without interfering with research essential to the development of higher-voltage and greater rupturing capacity circuit breakers. In this connection, Sir Claude refers to the opening last month of the company's extended research station.

In dealing with the accounts, Sir Claude mentions the consolidation of the accounts of the Bushing Company. The issue of 1,017,647 ordinary shares at 40s last November enable the company to take up its quota of ordinary shares offered by C. A. Parsons & Co. and also provided a substantial cash balance to help meet taxation demands, the cost of the e.h.v. assembly shop extensions and other projects.

The capital distribution of 2½ per cent (tax free) is made from the surplus of £100,476 arising from the sale of the company's holding in Morphy-Richards, Ltd.

The Rheostatic Co., Ltd.—In his circulated statement, Mr. M. J. Gartside (chairman and managing director) says that the turnover during the year under review increased slightly as compared with the previous year's record. The domestic market showed some hiatus a year ago, but has continued its growth following the removal of restrictive controls and as a result the order book is more satisfactory than a year ago. Direct exports show a modest increase, and in addition an appreciable percentage of equipment supplied to the home market is destined for use overseas, notable contracts being Satchwell resistors for ultimate dispatch with main equipment to railway undertakings in Australia and South Africa. Some recession had taken place in trade in France and South Africa, but since the close of the accounts the subsidiaries in those countries are now attaining higher rates of turnover than ever before in their history. A new subsidiary, Satchwell Controls (Canada), Ltd., commenced trading in October last to further sales in that country.

Franco Signs, Ltd.—In his review of 1953, Mr. J. F. Mallabar (chairman) says that the main operating company, the Franco-British Electrical Co., Ltd., has had a successful year. The rebuilding of the main works at Hendon has been virtually completed. Referring to the activities of subsidiaries, the chairman says that Franco Traffic Signs, Ltd., has increased its number of local authority customers. They have sold a part of their shareholding in the South African company which ceases to be a subsidiary company. Their interest in the company will in future appear in the balance sheet as an investment.

The Telephone & General Trust, Ltd., is holding its annual meeting on 27th April. In his circulated statement Sir Alexander Roger (chairman), in referring to the operating companies, says that the Anglo-Portuguese Telephone Co., is now engaged on a new and intensive expansion and development programme whereby it is hoped that before the close of 1957 the waiting list will be insignificant. The expansion and development of the three telephone companies in the West Indies goes on apace and during 1953 the Jamaica Telephone Co. spent over £250,000 upon expansion and improvement. In Trinidad also expenditure continues and net additions to the company's plant involve over £238,000 in 1953. The Barbados Telephone Co. had 5,222 stations in service at the end of 1953.

Bylock Electric, Ltd.—Presiding at the annual meeting held on 8th April, Mr. C. A. Mathes (chairman) said that turnover was still running at a high level and the raw products which were in course of introduction last year were being marketed in satisfactory numbers. The additional premises taken over towards the end of the financial year were now becoming productive. Overseas trade to date was satisfactory, especially in the dollar areas, and home trade had expanded. Good quantities of the new three-brush floor polisher were coming off the production line, and this machine was in demand both abroad and in this country; the home market had to be restricted to token supplies. Permission had been received from the authorities to develop the site next door to their factory.

British Insulated Callender's Cables, Ltd., shows a group trading profit of £8,344,074 for 1953, against £9,522,076. After deducting £1,117,015 for depreciation and £2,819,395 (£4,869,146) for taxation, the net group profit is £3,998,336 (£3,464,435), of which £3,661,896 is attributable to the parent company. It is proposed to maintain the ordinary dividend for the year at 10 per cent by a final dividend of 7½ per cent. In addition, it is proposed to make a special distribution of 2½ per cent, without deduction of tax, from realized capital profits.

The Telegraph Construction & Maintenance Co., Ltd., reports a group profit for 1953, after providing £185,159 for taxation and £75,883 for research and development expenditure, and adding special credits of £61,342, of £222,584, as compared with £199,349 for the preceding year. Reserves receive £99,278, and it is proposed to pay a final dividend of 3¾ per cent together with a bonus of 1 per cent, making 8½ per cent for the year on the increased capital of £1,954,092. For the previous year the interim dividend was 5 per cent on £977,046, followed by a final dividend of 3½ per cent and a bonus of 1 per cent on the present capital.

Enfield Rolling Mills, Ltd., report a decline in the consolidated trading profit from £907,555 in 1952 to £729,572 for 1953; the net profit fell from £332,825 to £278,305, after meeting taxation and depreciation. The ordinary dividend, on capital increased by a scrip issue of 80 per cent, is 10 per cent. For 1952 the dividend was 10 per cent plus a 5 per cent bonus. The allocations include £175,000 to reserves (against £220,000) and a balance of £213,657 (£167,885) is carried forward.

The Watford Electric & Manufacturing Co., Ltd., reports a trading profit for 1953 of £79,811, as compared with £85,391 for 1952. After providing for taxation the net profit is £36,457 (against £24,475). It is proposed to pay a final dividend of 10 per cent, plus a bonus of 7½ per cent on capital increased by 60 per cent scrip issue. An interim dividend of 5 per cent was paid on the smaller capital. For 1952 the distribution on the smaller capital was 25 per cent, which included a bonus of 10 per cent.

Bankruptcies

J. W. Luker and **H. A. R. Phillips,** lately carrying on business in partnership at East Street, Lewes and at 206, High Street, Lewes, under the style of Gordon and Luker, electrical contractors.—Last day for receiving proofs for dividend 21st April. Trustee, Mr. J. S. Bradley-Hole, 7, Old Steine, Brighton.

G. S. Graham, Blackfriars Street, Carlisle, electrical engineer.—First and final dividend of 4¾d in the £, payable at the Official Receiver's office, 14, Lowther Street, Carlisle.

Liquidation

Belco London, Ltd., electrical wholesalers.—Winding up voluntarily. Liquidator, Mr. D. Winter, 39, St. James's Street, London, S.W.1, appointed 31st March.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Ashington (Northumberland).—24th April. U.D.C. Eighty electric cookers for the Darnley Road housing scheme. Surveyor, Council Offices.

Australia. — BRISBANE. — 16th June. State Electricity Commission for Queensland. 11 kV metalclad switchgear for the Wide Bay-Burnett Regional Electricity Board. (E.S.B. 8578/54. Ten/8859.)*

Durham.—24th April. Durham Hospital Management Committee. Electric lighting and power installation at Crossgate Hospital. Group engineer, Dryburn Hospital.

23rd April. County Council. Electrical installations in 11 police houses on the Owton Manor estate, West Hartlepool. County architect, Court Lane.

Egypt.—CAIRO.—4th May. Cairo Electricity and Gas Administration. V.r.i. cable. (E.S.B. 9251/54. Ten/8902.)*

India.—CALCUTTA.—3rd May. Damodar Valley Corporation. Three 55/50/20 MVA, 132/33/11 kW transformers. (E.S.B. 9021/54. Ten/8891.)* 10th May. Three 5 MVA, two 10 MVA, and two 15 MVA, 132/33 kV transformers. (E.S.B. 9000/54. Ten/8889.)*

Iraq.—BAGDAD.—17th May. Directorate General of Municipalities. Two 50 kW alternator sets. (E.S.B. 8834/54. Ten/8863.)* 31st May. Two 280/300 kW alternator sets. (E.S.B. 8833/54. Ten/8864.)*

New Zealand. — WELLINGTON. — 4th May. Post and Telegraph Department. Two 100 W radio-telephony transmitters. (E.S.B. 8842/54. Ten/8867.)* 15th June. Electrical fittings and conduit. (E.S.B. 8841/54. Ten/8856.)*

18th May. Stores Division, G.P.O. 4,000 switchboard lamps. (E.S.B. 8978/54. Ten/8881.)*

Pakistan. — LAHORE. — 28th April. Stores Purchase Officer, Punjab. 200 vertical turbine pumps. (E.S.B. 8831/54. Ten/8865.)*

Seaton Valley (Northumberland).—22nd April. U.D.C. Electrical goods for 154 houses. Surveyor, Council Offices, Seaton Delaval.

South Africa. — PRETORIA. — 23rd April. Transvaal Provincial Tender Board. Electric motors. (E.S.B. 8820/54. Ten/8861.)*

JOHANNESBURG.—28th April. Stores Department, South African Railways. Overhead track equipment. (E.S.B. 8584/54. Ten/8838.)*

United States.—PORTLAND, OREGON.—21st April. Bonneville Power Administration. Power circuit breaker. (E.S.B. 8913/54. Ten/8835.)*

18th May. Corps of Engineers. Turbines and governors for the Dalles Dam power house. (E.S.B. 8630/54. Ten/8850.)*

PASCO, WASHINGTON.—21st April. Franklin County Public Utility District No. 1. Electric cable. (E.S.B. 8645/54. Ten/8852.)*

DENVER.—11th May. Bureau of Reclamation. 110,000 kVA generator. (E.S.B. 9103/54. Ten/8869.)*

Uruguay.—MONTEVIDEO.—10th May. Ministerio de Salud Publica. X-ray apparatus. (E.S.B. 9034/54. Ten/8882.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Essex.—County Health Committee. Recommended. Equipment in connection with proposed two-way radio communication system for ambulance service (£6,080). —Pye Telecommunications.

Exeter.—Lighting & Cleansing Committee. Mercury vapour lanterns, including chokes, capacitors and wiring, and erection only of concrete columns (£4,397). —Revo Electric Co.

Portsmouth.—Contracts & Supplies Committee. 16,190 15 W coloured lamps for sea front illuminations (£1,282).—Wall & Attwooll.

South Shields.—Town Council. Stage lighting equipment at the Boys' Grammar Technical School (£885).—Watson-Norie.

Stockport. — Corporation. Recommended. Electrical installations in 53 houses, Brinnington neighbourhood unit (£1,932).—Jones, Morris & Co.

Walthamstow. — Borough Council. Electrical installations in houses, Falmouth Avenue and Gordon Avenue estates (£1,120).—Cowlans.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Acton.—Factory, Coronation Road; Multi-Projects, Ltd., 2a, The Broadway, Beaconsfield, Bucks.

Factory; E. P. Barrus (Concessionaires), Ltd., tools and garden equipment, 12, Brunel Road, London, W.3.

Bacup.—Clinic (£11,000); G. Noel Hill, county architect, Preston.

Bath.—Houses (300), Whiteway estate; city architect.

Bicester.—Dwellings (100), western development scheme; L. K. Watson, architect to U.D.C., 6, Gray's Inn Square, London, W.C.1.

Birkenhead.—Additions to Rock Ferry High School (£31,390); borough architect, Wexford Road.

Blackpool.—Offices and warehouse in Clifton Road; T. Robinson, Sons & Co., Ltd., provision merchants, Nile Street, Hull.

Boreham Wood.—Factory; Isopad, Ltd., 30, Rosemont Road, London, N.W.3.

Bournemouth.—Factory in Wallisdown Road; Good Listening, Ltd., 19, Craven Park Road, London, N.W.10.

Bradford.—Slipper baths, Akam Road; city architect.

Brentford.—Works extensions, Great West Road; Raleigh Industries, Ltd., Nottingham.

Buxton.—Extensions to works at Lightwood Road for A. W. Hewetson, Ltd.

Chester.—Church, house, hall, etc., proposed in Norris Road, Blacon; Chester Diocesan Board of Finance, Abbey Chambers, Chester.

Chesterfield.—Block of 36 flats, Pevensey estate; borough engineer and surveyor.

Clay Cross.—Cinema on site of old Hippodrome (£25,000); H. Elton Cinema Circuit, Commerce Chambers, Elite Buildings, Nottingham.

Crayford.—Flats (31), Erith Road, Barnehurst; U.D.C. surveyor, Town Hall.

Croydon.—Factory, New Addington; Thomas Pay & Son, 50, Deptford Church Street, London, S.E.8.

Dagenham.—Factory, Selinas Lane; G. A. Neill & Co., 23, Albion Street, London, W.2.

Doncaster.—Technical high school for boys in Armthorpe Road (£140,000); borough architect, 15, South Parade.

Edmonton.—Additional factory premises; Sparrow, Simmons & Sons, Ltd., Eley's estate, Angel Road.

Gillingham (Kent).—Houses (124), Twydalls Park estate; K. A. Hawkes, Ltd., builders, Minnis Road, Birchington.

Hailsham.—New 60-bed unit to be erected at Hellingly Hospital (£114,000); architect to South East Metropolitan Regional Hospital Board, 9, Hallam Street, London, W.1.

Harlow.—Factory, Kores Manufacturing Co., Ltd.; V. Hamnet, architect, Terlings, Gilston.

Hospital for the North East Metropolitan Regional Hospital Board; regional architect, 3, Queen Anne Street, London, W.1.

Ilford.—Public baths at Fulwell Cross, Barkingside (£625,000); K. F. B. Nicholls, town clerk, Town Hall.

Kerridge.—Factory, off Jacksons Lane; Eric Britton & Co., Ltd., Ingersley Vale Works, Bollington.

Leicester.—Dwellings (136), Nether Hall estate; S. J. Smith & Co. (Bideford), Ltd., Smith Road, Wednesbury, Staffs.

London. — BERMONDSEY. — Dwellings (303), Tower Bridge Road area; Clifford Culpin & Partner, architects, 3, Southampton Place, W.C.1.

KENNINGTON.—10-storey office block, Albert Embankment; National Dock Labour Board, 9, Upper Brook Street, W.1.

PADDINGTON.—R.C. secondary school, Maida Vale; Y. J. Lovell & Son, Ltd., builders, 6, Bathurst Street, W.2.

SOUTHWARK.—Development of site in Congreve Street/Townsend Street area; H. J. Searle & Son, Ltd., manufacturing upholsterers, 70, Old Kent Road, S.E.1.

Luton.—Offices and warehouse in Chapel Street; Palmer & Harvey, Ltd., wholesale tobacconists and confectioners, 85, Park Street.

Macclesfield.—Extensions to works at Fountain Street for Adshead & Geeson, Ltd.; Hood & Burrows, architects, 2a, West Street, Congleton.

Maidstone. — Extensions; Phillips Character Shoes, Ltd., 80, Week Street.

Middlesbrough.—Houses for the T.C. Builders: R. B. Bainbridge, High Street, Stockton (30); J. Gilmore & Son, Marton Road, Middlesbrough (26); and R. C. McInnes, Cumberland Road, Middlesbrough (24).

Newcastle - on - Tyne. — Proposed school, North Fawdon (£38,000); A. Anderson, Ltd., builders, Stanmore Road.

Ambulance depot, Millers Road (£15,000); city architect, 18, Cloth Market.

Flats (21), on two sites in the city; G. Kenyon, city architect, 18, Cloth Market.

Extensions to the offices; Selborne Engineering Co., Ltd., Selborne Gardens.

Northumberland. — Primary school, Longbenton (£115,000) and grammar school, Killingworth (£109,000); A. Anderson, Ltd., builders, Stanmore Road, Newcastle-on-Tyne.

Ambulance stations at Berwick and Broomhill and ambulance depot at Wide-open; county architect, County Hall, Newcastle-on-Tyne.

Oxford.—New block at Nuffield College, for university authorities; clerk of works, Mansfield Road.

Poole.—Omnibus station and offices; Hants & Dorset Motor Services, Ltd., Bournemouth.

Prudhoe-on-Tyne. — Houses (106), West Wylam, for U.D.C.; J. M. Angus, architect, 21, Lovaine Place, Newcastle-on-Tyne.

Redcar.—Rebuilding of the Central Cinema for Thompson's Enterprises, Ltd., Palladium Buildings, Middlesbrough.

Richmond (Surrey).— Flats (24); Farquharson & McMorran, architects, 14, North Audley Street, London, W.1.

Romford.—Church and hall, Chase Cross Road, Collier Row; J. H. Crowe, architect, 31, Squirrels Heath Avenue, Gidea Park.

Salisbury.—Services club on New Street Corner site (£150,000); Navy, Army and Air Force Institutes, Ruxley Towers, Claygate, Surrey.

Shardlow.—Houses (22), Pit Lane, Aston; T. H. Thorpe & Partners, architects, 41, Friar Gate, Derby.

Southampton.—Factory, laboratory and offices; Burts & Harvey, Ltd., Eling House, Totton.

Southwell.—Houses (62), Blidworth; S. Cooper, R.D.C. surveyor, Westgate Offices, Southwell, Notts.

Stoke Orchard.—Research laboratory; National Coal Board, Hobart House, Grosvenor Place, London, S.W.1.

Stourbridge.—First stage of College of Further Education (£122,615); A. H. Guest, Ltd., builders, Coalbourne Brook, Amblecote.

Tynemouth. — Factory additions at Norham Road for Great Northern Knitwear, Ltd.; G. H. Gray, architect, Camden Street, North Shields.

Wallasey.—Erection of secondary technical school, Mosslands Drive; Wm. Moss & Sons, Ltd., Roscoe Street, Liverpool.

Walsall.—Factory, Alumwell Road; J. & E. Sedgwick, 8, Upper Rushall Street.

Walton - on - Naze. — Houses (32), Second Avenue; G. V. Scammell, architect, 123, High Street.

Warrington.—Works extensions, Latchford; British Aluminium Co., Ltd., Norfolk House, St. James's Square, London, S.W.1.

West Bromwich.—Milk depot, Roebuck Lane; Birmingham Co-operative Society, Ltd., High Street, Birmingham, 4.

Whitehaven.—Houses (50), Homewood; borough engineer and surveyor.

Whitley Bay.—Modern school, Northumberland C.C. (£128,000); H. D. Burton, Ltd., builders, King Street, North Shields.

Wigan.—Houses (32), Shevington, for R.D.C.; J. W. Liptrot & Co., Ltd., Brook Lane, Pemberton, nr. Wigan.

Worksop.—Bungalows (50), Valley Road area; borough surveyor, Park House, Park Street.

UNITED STATES TRADE

Increase in Radio and Television Exports

FOR the first half of last year United States exports of electrical machinery and apparatus, excluding "special category," were valued at $425·8 million compared with $308 million during the corresponding period of 1952. It will be seen that the rise in the total value is accounted for largely by the continually expanding trade in radio and television apparatus. Refrigerating and freezing equipment is another line of advance, while noteworthy increases also took place in domestic appliances and telegraph and telephone equipment. Exports of most power plant decreased. Imports of electrical machinery and apparatus during the same period totalled $20·8 million, a rise of nearly 50 per cent on the first half of 1952.

Class of Goods	Jan.-June, 1953 $ (000)	Inc. or dec. $ (000)
EXPORTS		
Generators, d.c.	1,474	− 318
Generators, a.c.	2,423	+ 449
Steam turbine generator sets	3,476	− 12,354
Welding sets	4,748	− 354
Electrical generating sets, diesel	12,818	− 3,058
Self-contained lighting outfits, except diesel	5,598	− 142
Wind-driven generator sets	76	− 248
Storage batteries	4,814	+ 863
Flashlight batteries	3,398	+ 547
Dry, multiple cell batteries, except flashlight	2,533	− 873
Other dry and wet cell primary batteries	281	− 306
Power capacitors for power factor correction	459	+ 69
Power and distribution transformers, 500 kVA and under	2,950	− 96
Ditto, over 500 kVA	2,444	− 2,577
Fluorescent ballasts, regulators and speciality transformers	3,653	− 299
Mercury power rectifiers	336	+ 77
Rotating convertors, under 150 kW	2,428	+ 610
Ditto, 150 kW and over	1,759	+ 118
Rectifiers, including battery chargers, non-rotating	957	+ 5
Switchboards, panels and parts	8,577	+ 1,396
Oil circuit breakers and switches	1,856	+ 294
Power switches, circuit breakers and parts	6,645	− 1,441
Fuses and fuse plugs	528	− 79
Lightning arrestors and choke coils	696	− 372
Watt-hour and other integrating meters	565	− 46
Elec. quantity indicating instruments, non-recording	1,692	+ 123
Elec. quantity recording instruments	461	+ 37
Other elec. quantity measuring and testing instruments and parts	8,590	+ 2,465
Motors, under 1 h.p.	2,209	− 921
Motors, 1 h.p. and over	7,582	− 3,450
Elec. propulsion motors, generators and controls for land transportation vehicles	5,155	+ 300
Industrial motor controls and parts	6,614	− 579
Elec. mining and industrial locos	1,073	− 94
Portable electric tools	3,587	+ 36
Elec. household type refrigerators	37,573	+ 5,890
Elec. freezers, farm and home type	6,131	+ 4,534
Parts for refrigerators and freezers	6,836	+ 1,875
Flashlights	992	+ 107
Elec. fans	2,050	+ 314
Small filament lamps, miniature candelabra and intermediate base	2,321	− 45
Large filament lamps and other large base lamps	2,668	+ 1,230
Fluorescent, vapour and non-filament lamps	2,239	+ 385
Elec. household washing machines and parts	6,782	+ 2,143
Ditto vacuum cleaners and parts	1,696	+ 1,042
Other elec household motor-driven appliances and parts	3,910	+ 1,017
Elec. household cooking ranges and parts	3,081	+ 1,739
Ditto cooking appliances and utensils and parts	1,347	+ 733
Ditto heating appliances and parts	1,133	+ 420
Elec. commercial cooking and food services equipment and parts	1,087	+ 118
Elec. industrial furnaces and parts	2,202	+ 910
Elec. industrial heating units, devices and parts	1,159	− 190
X-ray tubes and valves and parts	607	− 337
Other X-ray apparatus and parts	3,579	+ 804
Elec. therapeutic apparatus and parts	355	− 78
Radio and television apparatus exclusive of special category type	138,477	+ 102,568
Telegraph apparatus and parts	5,725	+ 2,256
Telephone instruments	751	+ 54
Other telephone equipment and parts	17,620	+ 9,901
Bells, buzzers, annunciators, alarms and parts	923	+ 226
Spark plugs except aircraft type	1,652	− 996
Starting, lighting and ignition equipment and parts, except spark plugs	13,273	− 1,082
Conduit and fittings, except clay, including outlets and switchboxes	5,225	− 276
Elec. lighting fixtures, portable lamps and parts	5,381	+ 145
Insulated wire and cable	11,613	+ 1,644
Special category type	33,690	− 12,866
IMPORTS		
Electric lamps, metal filament	177	− 48
Brass bases for electric lamp bulbs	—	− 2
Vacuum cleaners and parts	43	+ 12
Other electrical machinery and apparatus	10,497	+ 805
Machines having elec. element or device as an essential feature, n.e.s.	10,094	+ 6,178